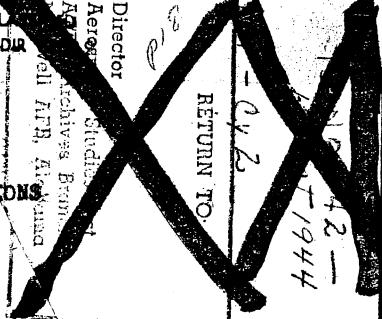


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HISTORY OF THE ORGANIZATION AND OPERATIONS  
OF THE  
COMMITTEE OF OPERATIONS ANALYSTS

#### I. ORIGIN OF THE COMMITTEE OF OPERATIONS ANALYSTS

On November 16, 1942, Major General Muir S. Fairchild, who had been serving as Director of Military Requirements at Headquarters, Army Air Forces, was designated a member of the Joint Strategic Survey Committee operating under the Joint Chiefs of Staff. The personnel of this Committee consisted, in addition to General Fairchild, of Vice Admiral Russell Wilson and Lieutenant General Stanley B. Embick. Its functions were:

- \*(a) To study and survey the major (basic) strategy of the war (past, present and future). (b) To keep the Joint Chiefs of Staff advised on combined basic strategy in the light of the developing and predictable situation. (c) To advise the Joint Chiefs of Staff on long-range strategy (combined). (d) To study the strategic possibilities to be adopted when current plans have become impracticable, and to advise the Joint Chiefs of Staff in regard thereto.\*

Shortly thereafter, there was presented to the Joint Chiefs of Staff by Headquarters, Army Air Forces, a plan for the bombardment of industrial objectives in the Western Axis. This plan, which was largely based on a study known as Air War Plans Division 1942, was subjected to severe criticism by the Joint Intelligence Committee to which it was referred. General Fairchild agreed with many of the criticisms of the JIC. As Director of Military Requirements, he had had considerable knowledge of the development of strategic war planning within Headquarters of the Army Air Forces. The subject was familiar to him for it was at his instigation that the Air Corps Tactical School at Maxwell Field,

## Report Documentation Page

*Form Approved*  
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE <b>1944</b>	2. REPORT TYPE <b>N/A</b>	3. DATES COVERED <b>-</b>
4. TITLE AND SUBTITLE <b>History of the Organization and Operations of the Committee of Operations Analysts</b>		
5a. CONTRACT NUMBER		
5b. GRANT NUMBER		
5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)		
5d. PROJECT NUMBER		
5e. TASK NUMBER		
5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>USAF Military Requirements Headquarters</b>		
8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		
10. SPONSOR/MONITOR'S ACRONYM(S)		
11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release, distribution unlimited</b>		
13. SUPPLEMENTARY NOTES <b>JFSC - WW II Declassified Records.</b>		
14. ABSTRACT		
15. SUBJECT TERMS		
16. SECURITY CLASSIFICATION OF:		
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>
17. LIMITATION OF ABSTRACT <b>UU</b>		
18. NUMBER OF PAGES <b>117</b>		
19a. NAME OF RESPONSIBLE PERSON		

Alabama, had undertaken about the year 1932 an industrial survey of the United States with a view to determining points of vulnerability to air attack. In the conduct of this survey, General Fairchild had not only laid the groundwork for a method of approach to the problem, but had had an opportunity to weigh the theories of Mitchell and Douhet and to integrate them with existing trends in weapons. At the time, the doctrines of the Air Corps Tactical School did not find favor with the higher echelons of the Army and the school itself was discontinued shortly before the war. However, certain former students, notably Brigadier General (then Major) Haywood S. Hansell, found their way into the intelligence branch of the Office, Chief of Air Corps, where they undertook to collect such information as was then available with respect to industrial objectives within Axis nations, together with the effect of German air attack upon Great Britain. The studies which were first undertaken in this section were developed by the Air War Plans Division, chiefly by Brigadier General Hansell, Brigadier General (then Colonel) Harold C. Craig, Brigadier General (then Major) Kenneth Walker, Brigadier General (then Major) Orville A. Anderson and Major General (then Lt. Colonel) Harold L. George. No attempt was made to narrow the field of possible objectives to those suitable for attack by a given air force; on the contrary, the studies were devoted to obtaining a maximum degree of production of aircraft in the United States and a maximum allocation of such aircraft to the Army Air Forces. It was upon the basis of the original Air War Plans Division study that the President made his famous statement that this country would require a production of 100,000 aircraft annually.

Upon the organization of the Eighth Air Force in the summer of 1942 and the departure for England of Lieutenant General (then Major General) Carl E. Spaatz and his staff, intelligence functions with respect to air matters were informally divided between A-2 and the

Eighth Air Force and the British. The preparation of target information material and the underlying basic studies with respect to industrial objectives in Axis Europe were made the province of the British and the Eighth Air Force, while the subject of the Far East was assigned to A-2. The principals in this arrangement were Colonels Henry W. Berliner and R. D. Hughes of the Plans Section, Eighth Air Force and Lt. Colonel Malcolm W. Moss, Chief of Target Information Section, A-2. The Office, Assistant Chief of Air Staff, A-2, had been occupied by several incumbents during the period from June 1941 to December 1942, among them, Brigadier General Martin W. Scanlon, Major General (then Colonel) Robert L. Walsh and, finally Brigadier General (then Colonel) Edgar P. Sorensen who assumed office on 22 June 1942.

In addition to A-2, various studies on industrial objectives within the Western Axis had been prepared by Military Intelligence Division of the War Department General Staff, by the Research and Analysis Section of the Office of Strategic Services, under the particular direction of Dr. Edward S. Mason, and by the Enemy Branch of the Board of Economic Warfare, under the particular direction of Mr. Fowler Hamilton. Information was exchanged between these organizations and the Ministry of Economic Warfare in the United Kingdom. In addition, a flow of information was maintained from the Royal Air Force and the Air Ministry to Washington.

On the afternoon of December 3, 1942, General Fairchild made an informal call upon Brigadier General (then Colonel) Byron E. Gates, Assistant Chief of Air Staff, Management Control. The writer occupied a desk in General Gates' office and was included in the conversation. After some general discussion, General Fairchild stated that he was disturbed at the preparation and handling of air matters for presentation to the Joint Chiefs of Staff and that it was inevitable that, with the pressure of daily affairs, officers holding responsible positions at Headquarters, Army Air Forces, found themselves unable to give the amount

of time to the research and analysis necessary to the formulation of plans and solution of strategic bombardment problems. He also pointed out that this type of activity was one for which a regular army career did not necessarily prepare an officer.

It so happened that General Fairchild had just read a study on the organization of the Army, Navy and Air Forces prepared by the writer after a considerable period of analysis and preparation. Furthermore, there had just been attached to the Office of the Assistant Chief of Air Staff, Management Control, Lt. Colonel (then Major) Walter B. Leach, with the function of establishing operations analysis sections in overseas air force commands. Operational research sections, composed largely of civilians, had proved their value to the Royal Air Force and authority to organize such sections in the Army Air Forces was granted by General Arnold under date of October 24, 1942.

The conversation turned upon analysis in general and General Gates mentioned the theory of the use of operations analysts to General Fairchild, stating that the writer and Colonel Leach were available to render him such assistance as he might desire. General Fairchild then turned to the writer and said "All right. I have a job for you. How can Germany be so damaged by air attack that an invasion of the continent may be made possible within a relatively short period, say one year?"

The exact machinery for the performance of the proposed task was not discussed with General Fairchild. It was apparent that the work might be undertaken in one of several ways: (1) for the Joint Strategic Survey Committee by a subcommittee, (2) for General Arnold in his capacity as one of the members of the Joint Chiefs of Staff and (3) for General Arnold in his capacity as Commanding General, Army Air Forces.

On December 4, 1942, General Gates addressed a memorandum to General Fairchild pointing out that there was nowhere within the machinery of the War Department or Joint Chiefs of Staff a group of analysts and research workers whose duty was to assemble all pertinent data and draw conclusions therefrom, that the formation of such a group or committee would not imply any criticism of the activities of any individual or group and that personnel of the Research and Analysis Section of the Office of the Assistant Chief of Air Staff, Management Control, were available on a loan basis to the Joint Strategic Survey Committee if desired. A copy of this memorandum is attached (Tab 1).

On December 5, 1942, the writer and Colonel Leach prepared two papers, one an outline of the proposed study (Tab 2), and the other an outline of necessary information (Tab 3). At the same time, at General Fairchild's oral request, a tentative form of directive was prepared, reading in pertinent part as follows:

"You are directed to prepare and submit to me a report as to the earliest practicable date for an invasion of Western Europe. This report will be based upon a collection and analysis of all relevant material wherever available!"

On December 8, 1942, General Gates and the writer conferred with General Fairchild. General Fairchild reviewed the papers above referred to and discussed the problem in some detail, stating that his conception was that the organization should deal with Germany's general economic structure with a particular view to determining weaknesses that might progressively be capitalized upon. This would result in a gradual deterioration of her industrial and military power to a point where direct attack would be feasible. The details of method of attack were not of prime importance in this connection. All that was necessary to know was the rate of availability of men and equipment. He further stated that the problem appeared to him to be primarily an Army Air Force problem and one to be handled under the authority of the

Commanding General thereof. After reviewing the directive, he rephrased the sections above quoted as follows:

"You are directed to have the group of operational analysts under your jurisdiction prepare and submit to me a report analyzing the rate of progressive deterioration that should be anticipated in the German war effort as a result of the increasing air operations we are prepared to employ against its sustaining sources. This study should result in an accurate estimate as can be arrived at as to the date when this deterioration will have progressed to a point to permit a successful invasion of Western Europe."

and stated that he would present it to General Arnold for signature.

On December 9, 1942, General Arnold signed the directive attached  
<sup>4</sup>  
(Tab B).

#### II. THE ORGANIZATION OF THE COMMITTEE AND ITS PRINCIPAL SUBCOMMITTEES

The matter of organization now became the first order of business. Colonel Leach, in the course of organizing the Operational Research Section of the Eighth Bomber Command, headed by Mr. John Harlan, had had occasion to talk to Mr. Elihu Root, Jr., senior partner of Mr. Harlan's firm, on operations analysis and related matters. At about the same period, he had had a discussion with Colonel Moss in which the latter outlined to him the extent to which the Target Information Section under his supervision had proceeded in the preparation of industrial studies. It appeared that Colonel Moss had contacted Dr. Edward M. Earle of the Institute for Advanced Study at Princeton, New Jersey, and that Dr. Earle and Colonel Moss' organization had had discussions with a view to selecting prime objectives for industrial attack. It was felt advisable to contact the three individuals named as soon as practicable and, accordingly, even before the directive was signed, Colonel Leach went to New York and interviewed Dr. Earle and Mr. Root. Both appeared interested and willing to give their time to the proposed study. Colonel Moss was also contacted and agreed to

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[REDACTED]

attend a proposed organisational meeting in General Gates' office on December 10. Dr. Earle and Mr. Root arrived in Washington on December 9. At Dr. Earle's suggestion, the original meeting was enlarged to include Dr. Edward S. Mason of the Office of Strategic Services, Mr. Fowler Hamilton of the Board of Economic Warfare and Mr. Noel Hall of the British Ministry of Economic Warfare.

Mr. Root's presence on the Committee was particularly fortunate. He brought to the study both good judgment and all-round wisdom in addition to a keen analytical sense. As senior partner of the law firm of Root, Clark, Buckner & Ballantine of New York City, Mr. Root had had many years' acquaintance with corporate problems. In addition, he had served as a director of numerous companies, including the American Telephone & Telegraph Company, and had maintained close personal contact with leaders in the field of business.

Dr. Earle had for many years been a student of military and economic affairs. At the Institute for Advanced Study at Princeton, he had concentrated on the history and potentialities of economic warfare and was the author of numerous articles on the subject.

Dr. Mason, before coming to Washington to build up the Research and Analysis Branch of the Office of Strategic Services, had been a professor of economics at Harvard. Dr. Mason was a member of the Joint Intelligence Committee and was well acquainted with strategic economic problems.

Mr. Hamilton had served as an Assistant to the Solicitor General before becoming Chief of the Enemy Branch of the Board of Economic

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Warfare. While in the Department of Justice, he had assisted in the preparation of many anti-trust cases and had thus acquired a peculiar knowledge of economic structures.

On December 10, the first meeting of the Committee was held. General Fairchild addressed the meeting at some length, explaining the problem, outlining certain possible methods of approach and indicating the necessity for thoroughness as well as speed. In addition to General Fairchild, the following were present:

Brigadier General (then Colonel) Byron E. Gates  
Colonel Guido R. Perera  
Colonel (then Lt. Colonel) Malcolm W. Moss  
Colonel (then Lt. Colonel) Joseph W. Clark  
Lt. Colonel (then Major) Walter B. Leach  
Major (then Captain) Arthur M. Wood  
Dr. Edward S. Mason  
Mr. Elihu Root, Jr.  
Mr. Noel Hall  
Dr. Edward M. Earle  
Mr. Fowler Hamilton

The name chosen for the Committee was the Advisory Committee on Bombardment. Before adjourning, a subcommittee was formed to analyze and select enemy industries in order of their relative importance and to make a classification for the purpose of initiating further detailed studies. The Chairman, Dr. Earle, held a lengthy conference on December 15, 1942, with Mr. Root, Colonel Leach and the writer at which it was determined to divide the principal elements of the German industrial and military potential into three general categories as follows:

PRIORITY A - Those which on grounds of indispensability or vulnerability and direct relation to German capacity to resist invasion appeared to offer most promise as targets in the sense that they would bring about the most rapid deterioration of enemy military power in the year 1943.

PRIORITY B - Those elements in the German military and economic potential which would be seriously affected by attrition over a longer period of time.

PRIORITY C - Those items in the German economy which, however important in themselves, offered unsatisfactory targets or which could be effected only indirectly by some such method as interference with transportation, electric power, sources of raw materials or otherwise.

In addition, it was felt that a broad survey of the German economy should be instituted with a view to obtaining the picture as a whole and to discovering items previously overlooked which might prove critical to the German war effort.

The following industries were tentatively placed in Priority A:

Aircraft  
Electric Power  
Oil  
Rubber  
Transport  
Chemicals  
Electrical Equipment  
Submarine Operation

In priority B, were placed the following:

Aluminum  
Non-ferrous metals  
Automotive industry  
Ammunition  
Explosives  
Coke  
Foodstuffs and fertilizers  
Ordnance  
Iron and steel  
Machine tools and precision instruments  
Plastics  
Submarine construction  
Submarine torpedoes  
Textiles and synthetic fibres

In priority C were placed the following:

Heavy steel fabrication  
Coal  
Shipping.

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Targets which offered greater promise for area bombardment than for precision attack were not considered. It was strongly felt, however, that it would be highly desirable to coordinate American and British bombardment practice in order that maximum results might be achieved.

On December 16, 1942, the second meeting of the main committee was held. At this meeting two new members were present, both of whom had been obtained through the personal intervention of General Fairchild: Brigadier General Sorensen of A-2 and Colonel (then Lt. Colonel) Thomas G. Lanphier of the Air Unit, Military Intelligence Division, War Department General Staff.

The purposes of the meeting were to discuss the report of the subcommittee which had conducted a preliminary survey of German industry and to consider a report of the subcommittee on petroleum headed by Mr. Fowler Hamilton. After an extended discussion as to sources of information in general, Mr. Hamilton presented a memorandum defining the proposed scope of the petroleum study and the method of approach (Tab 5). This memorandum is of particular interest. Although numerous studies had been conducted by various agencies with respect to industrial objectives in Western Axis, no common method of approach had been developed nor had the results been carefully integrated with an analysis of the force required to accomplish the destruction desired. Mr. Hamilton's memorandum divided the work of his subcommittee into four parts: (1) a section listing and describing all facilities required to produce petroleum products; (2) a section on supplies and requirements, including the elements of capacity, present production and consumption, stocks on hand, and requirements with reference to particular needs including the possibilities of decreased use and substitution for the products; (3) a section on the physical vulnerability of the industry to air attack and (4) a section with respect to effect on enemy military capabilities of destruction of the most important targets, together with

the approximate time when the maximum effect would be felt. The Committee discussed and endorsed Mr. Hamilton's method of approach but voted to eliminate from various industry subcommittee reports any consideration of the amount and kinds of bombs required, it being felt that this problem could be handled most effectively by a separate subcommittee on probabilities and force required. The minutes of the meeting indicate that the members were anxious to avoid purely theoretical conclusions; calculations of force required were deemed essential to contribute an element of reality to the study. The Committee was aware of the fact that one of the purposes of the study was to inform higher echelons, not only of the economic validity of a given system of strategic air attack but of the approximate size of the force which would be required to be employed to successfully accomplish its destruction.

A subcommittee on force required was organized on December 14, under the chairmanship of Brigadier General Sorensen. It consisted originally of the following members, in addition to the chairman:

Colonel C. G. Williamson of the Directorate of  
of Bombardment  
Lt. Colonel C. B. Thornton, Director of  
Statistical Control  
Mr. G. B. Dantszig, Office of Director of Statistical  
Control  
Dr. Heinike, Eglin Field  
Mr. Elihu Root, Jr.  
Major R. E. Foss, A-2  
Mr. D. B. Dyer, A-2.

Shortly thereafter, as a result of a conference held with Dr. Vannevar Bush, Director of the Office of Scientific Research and Development by *Dr. Leach*, Mr. Root, Colonel Leach and the writer, Dr. John E. Burchard of OSRD, an expert on explosives, was added to the subcommittee.

The first meeting of the subcommittee on probabilities and force required was held on December 14, 1942. At this meeting, the writer suggested that the study should divide itself into three parts: (1) an

economic review of German industry with a view to establishing priority among targets, (2) an estimate of the forces available and (3) an estimate of the destruction which might be achieved by such forces. Colonel Williamson expressed the view that too many detailed plans had been made to date in the absence of a single entire war plan covering every theatre; that only the Joint Planners could undertake such a study; that no one could furnish the Committee with a definitive statement of the number of bombers which would be made available for attack on the Western Axis during 1943 and 1944 and that it was practically hopeless to attempt to correlate all the proposed separate industry reports. On the other hand, the question as to how many bombs were required to inflict a certain amount of damage was a simple mathematical proposition. This gave rise to an extended discussion. General Sorensen stated that he believed the subcommittee would proceed upon the basis that existing allocations of aircraft would be maintained. Mr. Root argued that the first step was to determine the economic effect of destruction of selected targets and the second was to estimate the force necessary to accomplish it. These factors would enable superior authority to arrive at a specific decision even in the absence of an overall war plan.

During the days immediately following, subcommittees were set up on the A and B priority industries, including, in addition to petroleum and force required, aircraft, electric power, transportation, electrical equipment, rubber, chemicals, coke, non-ferrous metals and machine tools and precision instruments.

The aircraft subcommittee, under the chairmanship of Brigadier General Sorensen, included the following original members:

Colonel Malcolm W. Moss, A-2  
Mr. Charles P. Kindelberger, Office of Strategic Services  
Lt. Colonel Charles C. Morgan, A-2  
Major C. W. Daniel, A-2  
Mr. Paul H. Wilkinson, Board of Economic Warfare.

The electric power subcommittee, under the chairmanship of Colonel <sup>Major (then)</sup> Moss, originally consisted of Captain James T. Lowe, A-2; Mr. James T. Wilton, A-2; and Mr. Otto Strauss, Board of Economic Warfare.

The subcommittee on transportation was headed by Dr. Ralph J. Watkins of the National Resources Planning Board who had recently prepared an overall study on transportation in the United States for a President. Dr. Watkins' name had been suggested by Dr. Mason. In addition to the chairman, the subcommittee consisted of Dr. Edward S. son, Office of Strategic Services, Mr. Wilford Owen and Mr. Emert Williams of the National Resources Planning Board and Captain Paul <sup>com of</sup> A-2.

The subcommittee on electrical equipment was under the chairmanship of Mr. Herbert B. Peirce, one of the vice presidents of International General Electric Company. Mr. Peirce had had 14 years' experience in Germany up to and including 1940; his name was suggested to Mr. Root by Mr. Clark H. Minor, President of the company. In addition to Mr. Peirce, the services of Major A. J. Carey and Major Sherman R. Thayer were obtained on loan from the office of the Director of Communications. Major Carey had previously been an operational analyst with the American Telephone & Telegraph Company.

The subcommittee on rubber consisted originally of Colonel Moss as chairman and Captain Lowe; that on chemicals consisted of Mr. Fowler Wilton as chairman, Dr. Edward S. Mason and Major (then Captain) James <sup>Major</sup> of A-2.

The study on the Overall Investigation of the Western Axis Economy was assigned to Mr. Otto Tolischus, Foreign Correspondent for the New York Times who had had many years' experience in Germany and had devoted himself to economic studies. Mr. Tolischus' name was suggested by Dr. Hale.

The study of coke was under the chairmanship of Dr. J. Z. Schneider

of the Board of Economic Warfare, assisted by Major Luke of A-2.

The study on non-ferrous metals was under the chairmanship of Lt. Colonel (then Major) Neil W. Rice, formerly President of U. S. Smelting and Refining Company.

The study on machine tools and precision instruments was headed by Mr. Erik Oberg, Editor of "Machinery". Mr. Oberg was recommended strongly to the writer by the Chief of the Machine Tool Section of the War Production Board for his general knowledge of machine tools and for his specialized knowledge of German machine tool plants. He was assisted by Mr. Lawrence Harris of the Board of Economic Warfare.

### III. THE FIRST INTERIM SUBCOMMITTEE REPORTS

On December 21, less than two weeks after the organization of the Committee, first interim reports were received from the subcommittees on electric power and aircraft.

The report of the subcommittee on electric power disclosed that a considerable amount of work had been done on this subject by A-2, particularly with respect to (a) the essential characteristics of the industry, (b) supply and requirements and (c) vulnerability. Nothing, however, had been done with respect to calculating the results of an attack. It was clear, however, that the intricate German grid system rendered a general attack impracticable and that the only possibility of inflicting substantial damage was through the isolation of certain particular regions. The Committee therefore instructed the subcommittee to proceed with the study of specific regions within Germany.

The report on aircraft revealed that considerably less coordinated groundwork had been ~~accomplished~~ undertaken to date and that much fundamental material was from British sources.

The following day, December 22, the reports on rubber and transportation were presented. With respect to the rubber report, it appeared that

o plants produced in excess of 50 per cent of Germany's synthetic  
bber and that they were relatively vulnerable to air attack. The  
mmittee felt that the sections on requirements and stocks should be  
bstantially improved. The transportation report revealed that the  
oblem necessitated consideration of attacks on river and canal  
ansportation and coastwise shipping as well as railroads. This was  
rticularly true of traffic on the Danube by means of which a substan-  
al portion of Rumanian oil found its way north.

On December 23, the Committee met for the purpose of considering  
e first report from the subcommittee on electrical equipment which  
s presented by Major Carey. It appeared that there was a wide geo-  
aphical dispersion of the electrical equipment industry within the  
tern Axis and that electronic equipment presented an interesting  
ough complex field for air attack. The subcommittee stressed the  
lection of (1) specific targets directly related to weapons used in  
mbat, (2) essential items for the operation of combat vehicles, etc.,  
ch as magnetos or submarine batteries and (3) raw materials or compo-  
nts used in the communications industry and which might prove potential  
ttlenecks.

The Committee next received first interim reports on oil and  
emicals. The petroleum report was presented by Mr. Hamilton and the  
emical report by Messrs. Mason and Alexander. It appeared that the  
fining capacity of Germany and Axis-dominated countries greatly  
ceeded production and consumption both in natural and synthetic  
oducts. After extended discussion a tentative conclusion was reached  
at the Bergius hydrogenation plants, because of their great flexibility,  
d perhaps certain segments of the oil transportation system, merited con-  
deration as targets. In the discussion on chemicals, Dr. Mason pointed  
t that synthetic rubber represented one of the best targets and that,  
nerally speaking, even complete destruction of any other branch of the

industry would produce but a negligible immediate effect on front-line military strength either because of large stocks or because only a small percentage of the product went into direct military use. Mr. Alexander pointed out that explosive plants were designed to withstand or minimize explosions; that explosives could be made in any of the numerous dyestuffs plants in Germany and that propellant plants were not too well identified. The general conclusion was that not too much could be hoped for in the chemical field but that further study should be directed toward propellants, by-products of coke and synthetic rubber.

**IV. THE FIRST INTERIM COMMITTEE REPORT AND THE SPECIAL INTERIM REPORT ON OIL.**

Although the members of the Committee were not then aware of the fact, it was desired that the study upon which they were engaged should be completed before the forthcoming Casablanca conference between President Roosevelt and Prime Minister Churchill and their staffs. This meeting was scheduled for and was in fact held commencing in the middle of January. The scope of the problem was such, however, that it was clearly impossible to complete a report in time for submission prior to the conference. At General Fairchild's suggestion, therefore, two separate interim reports were submitted: a first interim report on Bombardment Objectives in Axis Europe (Tab F) and a tentative memorandum on the Western Axis Oil Industry (Tab G). The latter recommended destruction of the 14 Bergius hydrogenation plants, three tetra-ethyl lead plants, 11 Fischer-Tropsch synthetic plants, and the Ploesti refineries. It was estimated the net effect of this destruction would be to eliminate the production of 4/5 of all petroleum products, including 75 per cent of aviation gasoline production. The permanence of the blow would depend upon the degree to which transportation of Rumanian crude oil to points elsewhere in Europe where excess refining capacity existed could be inhibited. Although stock estimates of all petroleum products submitted

to the Committee varied between two months' and six months' requirements at the then rates of consumption, it was concluded that the Axis position, particularly as regarded aviation gasoline, was closely balanced and might become critical.

The interim report concluded as follows:

"6. Early indications - Some things are already beginning to emerge clearly:

"It is clear that it is better to cause a high degree of destruction in a few really essential industries or services than to cause a small degree of destruction in many industries.

"It is clear that results are cumulative and that a master plan, once adopted, should be adhered to with relentless determination.

"It is clear that our day operations and the night bombing of the Royal Air Force should be correlated so that both may be applied to the same system of targets, each at the point where it is most effective.

"It is already clear that with the force available during 1943, concentrated on the right targets, very grave injury can be done to the Western Axis economic system.

"There are substantial grounds for hoping that the study now in hand, if pressed further, may indicate that this injury will critically impair the military strength of the Western Axis."

#### V. PROGRESS AND DEVELOPMENT OF THE SEVERAL SUBCOMMITTEE REPORTS

On December 30, the Committee met for the purpose of receiving interim reports on rubber, aircraft, coke and electrical equipment. The interim report on rubber resolved itself into a discussion of the amount of natural rubber obtainable through blockade running, the amount of rubber which might be reclaimed and requirements figures.

The aircraft subcommittee reported that they had cabled the RAF in London for certain information but that no reply had been received to date and that the RAF Delegation claimed that the Air Ministry A.I.a.(a) reports were the only available source of fundamental data. These reports gave monthly output for assembly plants by types but did not cover productive capacity. It appeared that British figures differed from those used by G-2 and A-2, the British figures being more optimistic. It

was pointed out that it would be necessary to make a thorough analysis of the flow of components into finished aircraft in order to determine if there were any bottlenecks at any point in the process. The time lag between the effect of bombing aircraft assembly plants or engine plants and reduction of front-line strength was also discussed.

The report on coke revealed that that industry was important for three reasons (a) because it was basic to the production of steel in large quantities; (b) because it was basic to the production of fuel gas; (c) because its by-products were basic to the chemical and explosive industries. German coking capacity appeared considerably in excess of minimum requirements for steel and coke oven gas but not for by-products. There were some 800 coke oven batteries in Axis Europe in four concentrations, principally in the Ruhr, the Saar and in Silesia. Although highly vulnerable to a direct hit with a 500-pound bomb and perhaps even to small calibre cannon fire, it was felt that the task of destroying any substantial percentage was of extraordinary magnitude.

The electrical equipment report revealed that contacts were being made with Dr. Jewett of the Bell Laboratories, Dr. Phillips of Phillips Lampen, an official of the Telefunken Company and various foreign experts.

On December 31, the Committee met for the purposes of receiving further reports on transportation and electric power and first interim reports on non-ferrous metals, machine tools and probabilities. Two areas had been selected by the subcommittee on electric power for specific study - one the Rhine-Ruhr area, the other the area south of Berlin, referred to as the Central German Industrial Area. It was stated that destruction of 29 targets within the Rhine-Ruhr area would reduce power output 57 per cent. These targets included switching and transformer stations selected for the purpose of cutting off the area from the German grid system. The length of time during which this isolation could be achieved was not entirely clear. The number of targets to be destroyed in the Central German Industrial Area was not stated. A discussion

followed as to the power situation in Italy, it being pointed out that there were a great number of small hydro-electric generating plants in the several river valleys of that country.

Dr. Watkins presented an exhaustive report on transportation. It appeared that railroads handled about half the freight movement within the Western Axis. Motive power was an interesting though difficult objective; a minimum of 17,500 locomotives would have to be destroyed before a theoretical breaking point would be achieved. Attack on locomotives might be supplemented by attack on shops performing 55 per cent of heavy repair work. The difficulty was that there were at least 200 targets, other than locomotives on the line, which would have to be attacked, many of which would have to be subjected to repeat attacks.

The subcommittee on non-ferrous metals reported that the problem was being attacked through separate studies on copper, zinc, lead, nickel and aluminum.

The report on machine tools proved of particular interest. On December 20, 1941, the writer had had occasion to meet Mr. Sexton Wolmar at an informal social gathering at the home of his father-in-law, the Swedish Minister, Mr. Bestrom. The writer had known Mr. Wolmar for some years. The conversation ranged on various general subjects when Mr. Wolmar suddenly said "I see that you are now in the Air Corps. Why doesn't the Air Corps knock out the ball bearing plants at Schweinfurt? Germany could not get along without them." This remark appeared particularly significant to the writer because of the fact that Mr. Wolmar was Vice President of the SKF Company at Philadelphia, an important producer of ball bearings in this country. The president of the company, and a close friend of Mr. Wolmar's, was Mr. William Batt, then <sup>Vice Chairman</sup> ~~Administrative~~ Assistant, War Production Board. The War Production Board was charged with the duty of organizing production for war in this country. When, therefore, Mr. Oberg arrived in Washington to take over the machine tool study, the writer suggested to him that anti-friction bearings be given

an important place in his study. Mr. Oberg stated that he felt that this would be logical and that he was positive they would prove particularly important. In his report, Mr. Oberg pointed out that Axis machine tool industry had been analyzed, various plants located and their relationship to the various segments of the enemy's war effort established. It was his opinion that the best target was the anti-friction bearing industry. Four plants in Schweinfurt, one in Stuttgart and one in Berlin accounted for the greater part of production. Anti-friction bearings were essential to the manufacture of aircraft, automobiles, tanks and machine tools. The Berlin plant which concentrated on aircraft bearings appeared to be a particularly difficult target. The equipment necessary to manufacture anti-friction bearings was specialized and could probably not be replaced in less than six months. The plants themselves were not of sturdy construction and appeared vulnerable to fire.

Brigadier General Sorensen, for the subcommittee on probabilities, submitted a most interesting report. The subcommittee's first problem had been to establish certain working figures. Differences in results of calculations of bombing probabilities could be enormous; they are influenced to a major degree by such items as estimated probable error, the state of training, the effect of combat conditions, the height from which bombing was carried out, the percentage of assurance of securing a hit on a given spot postulated, the number of abortive sorties, that is to say, the number of aircraft dispatched which did not arrive over the target for one reason or another, the method of dropping bombs, whether in train or otherwise, the ballistics of the bombs used, the selection of aiming points and the blast effects of the bombs themselves. Estimated probable error was arrived at by measuring the distance between impacts of a given number of sample bomb falls. The difficulty in arriving at a

figure for working purposes was that results achieved in training had to be modified in accordance with experience in the several theatres, that results varied sharply between theatres. Experience of the Eighth Air Force gained in its first 1100 sorties indicated an average estimated probable error of 1239; it was felt that this figure reflected lack of training and was too pessimistic as a criterion for the future. It was General Sorensen's opinion that it would be necessary to figure bombing probabilities from an assumed altitude of 25,000 feet because of the accuracy of German anti-aircraft fire. It was a fact that the range of error increased geometrically to the height; for example, at 20,000 feet, the error would be twice what it would be at 12,000 feet. Another important factor was the degree of certainty of success demanded of a given mission. The force required to achieve a degree of success of 90 per cent or above would be very much larger than that required to achieve a figure of 50 per cent. The number of hits desired and the type of bomb to be used would depend, in turn, upon an analysis of construction and vulnerability of each portion of the target. The number of aircraft which would have to be dispatched to insure the arrival of an adequate force over the target would have to be corrected for abortive sorties. Such abortive sorties were caused to some extent by engine trouble and personnel failure, but principally by bad weather. It was believed that the flight characteristics of the various types of bombs were quite uniform and that the matter of selecting aiming points was a complicated and long process. The vulnerable features of each target would be indicated by the industry subcommittees; it would then be up to the probabilities subcommittee to estimate the number and size of bombs required for destruction.

#### VI. THE ADDITION OF MR. THOMAS W. LAMONT TO THE COMMITTEE

After the submission of the Committee's interim report and its report on the oil industry, certain questions arose with respect to the extent of General Arnold's acquaintance with the progress of the Committee's work. Mr. Root was of the opinion that the nature of the project required that General Arnold be kept continuously informed and accordingly undertook to obtain an interview with General Arnold at which the matter of the Committee's work was thoroughly discussed. Mr. Root suggested to General Arnold that it might be advisable for him to obtain the services of some outstanding industrialist as a "senior economic adviser". Various names were discussed, among them those of Mr. Walter Gifford, of the American Telephone and Telegraph Company, Mr. George L. Harrison, Chairman of the Federal Reserve Bank of New York, and Mr. Thomas W. Lamont, senior officer of J. P. Morgan & Co. All three were men of outstanding ability and close friends of Mr. Root's. As Mr. Root believed it would be more difficult for either Mr. Gifford or Mr. Harrison to give any substantial time to the undertaking, General Arnold telephoned Mr. Lamont and asked him to come to Washington for a conference. The next day, January 7, 1943, Mr. Lamont came to Washington where he conferred first with General Arnold and then with Mr. Root and the writer. Mr. Lamont indicated that he would be willing to devote as much time as was necessary to the work in hand and that as soon as he could make the necessary arrangements with his associates, he would come to Washington on a full-time basis. The necessary papers for his appointment as a special consultant were executed and Mr. Lamont returned to Washington on the morning of January 12. He immediately set out to acquaint himself with the work of the Committee and of the various subcommittees. Mr. Lamont proved of invaluable

istance to the Committee. He brought to the Committee a wide knowledge of industry, both in the United States and in Europe, together with a source of personal contact with leaders in the field of industry and banking. In addition, he contributed a high degree of perspicacity and balanced judgment to the analysis of a type of problem for which no precedents existed.

When he first arrived, Mr. Lamont suggested to Mr. Root that it might be desirable for him to call on the Secretary of War whom both and Mr. Root had known personally for many years. Mr. Root felt, however, that, as Mr. Lamont was working "in the back room" for General Arnold, it was unnecessary for him to pay any formal call upon the Secretary. Subsequent events proved, however, that Mr. Lamont's original intuition was correct. When the question arose as to the members of the Committee who should proceed to England for the purpose comparing their material with that in the possession of the Eighth Air Force and the British, Mr. Lamont's name was one of those selected. General Gates, together with that of Mr. Root, Colonel Leach, Mr. Milton and the writer. On the morning of January 26, while this question was under discussion, Mr. Lamont had an interview with the Secretary of War at which the Secretary expressed some surprise that Mr. Lamont was working in the War Department without his knowledge or that of the Assistant Secretary of War for Air, Mr. Lovett. Various interviews were held between the Secretary, Mr. Root and Mr. Lovett as a result of which the Secretary indicated that he believed it was necessary for Mr. Lamont to undertake any form of overseas travel and that it would perhaps be best for future contacts to be established with him in New York. At the same time, Mr. Root was informed by Mr. Lovett that, due to his being a director of Pan American Airways, it would be best for him not to proceed to England where the matter of post-war liaison was in issue. In General Arnold's absence, representations were made to General Stratemeyer, Chief of the Air Staff, to the same

effect and, accordingly, neither Mr. Lamont nor Mr. Root were included in the original group which proceeded to England. Upon learning of this turn of events, Mr. Root had an interview with the Secretary and with Mr. Lovett at which the entire issue was reviewed, the status of target analysis to date was thoroughly discussed and a decision was reached not only that Mr. Root should proceed to England, but that Mr. Lamont should continue as a member of the Committee. This decision is incorporated in two documents: a letter from the Secretary of War to Mr. Lamont (Tab 8) and a memorandum to General Stratemeyer from Mr. Lovett (Tab 9).

VII. PROGRESS ACHIEVED PRIOR TO THE DECISION TO SEND REPRESENTATIVES OF THE COMMITTEE TO THE UNITED KINGDOM

During the period from 31 December 1942 to 21 January 1943, the subcommittees were hard at work in their respective fields. New subcommittees were set up on the following subjects:

- (a) Food, under the chairmanship of Captain Scott, of A-2.
- (b) Anti-aircraft and Anti-tank Artillery, originally under the chairmanship of Colonel R. R. Studler, Ordnance.
- (c) Motor Vehicles, under the chairmanship of Mr. Robert Ellibee of the War Production Board.
- (d) Iron and Steel, under the chairmanship of Mr. Philip Reinartz of the War Production Board.

Messrs. Ellibee and Reinartz were obtained as a result of a conference held by the writer with Mr. William Batt. At this conference, Mr. Batt expressed himself strongly in favor of the selection of the ball bearing industry as an outstanding industrial target, stating that ball bearings had proved a bottleneck in this country and that he was convinced the same was true in Germany. Mr. Batt referred the writer to Mr. Batcheller, Chief of the Iron and Steel Division of the War Production Board and former president of the Allegheny-Ludlum Steel Corporation, who stated that he believed Mr. Reinartz well qualified to handle the problem.

Mr. Batcheller's suggestion, Mr. Earl Smith, Vice President of Republic Steel Corporation, was added to the subcommittee. The other members consisted of Mr. W. Parke Armstrong of the Board of Economic Warfare, Major Lowe and Major Luke of AW2. The food subcommittee consisted of the Airman and Dr. Mason. The motor vehicle subcommittee consisted of the Airman and Major Webster of AW2. Mr. Paul Pleiss, former production engineer in Europe for the Budd Manufacturing Company prepared a lengthy report for the subcommittee.

The report on food indicated that a reduction of 35 per cent would be necessary before a critical point could be achieved; that, although attacks on facilities for the production of nitrogenous fertilizers would be the most immediate effect on future production, there were a large number of targets involved; and that attacks on storage facilities, if undertaken, should be concentrated on grain warehouses because of the hazard of dust explosions.

The subcommittee on motor vehicles pointed out that some 40 plants were producing tanks and that some 25 were producing armored force vehicles; <sup>thus</sup> <sup>in</sup> <sup>the</sup> <sup>case</sup> <sup>of</sup> <sup>light</sup> <sup>trucks</sup>, ~~Opel~~ Brandenburg was the largest producer. It was felt that a considerable idle motor vehicle industry existed in America. The subcommittee doubted that the internal combustion engine field offered any promise because of the idle capacity and decentralization of production. It was recommended that further study be devoted to Diesel engines for submarines and to component parts for the motor vehicle industry generally. The report of the subcommittee was deemed unsatisfactory. The project of diesel engines for submarines was later assigned to the subcommittee.

on submarines. Subsequent to the visit to the United Kingdom of representatives of the Committee, a special study on military transport vehicles was initiated. Although this did not result in any final subcommittee report, the results were incorporated in the final report of the full Committee. It was therein estimated that truck losses were running at twice the production rate, that production itself amounted to only 10 per cent of total equipment, that no substantial number of motor vehicles could be withdrawn from industry, that military holdings were near the estimated minimum divisional requirements and that so-called "idle" capacity had actually been converted to production of high priority armaments, thus making it unavailable for truck production.

On 13 January, 1943, the Committee met to receive further reports on machine tools, non-ferrous metals and transportation. Mr. Oberg reported that his subcommittee, since its inception, had increased the scope of its study to include three industries separate from machine tools but closely related to and basic to the latter: (a) ball bearings, (b) precision measuring instruments and (c) grinding wheels. In Mr. Oberg's words, "Briefly, these are the machines by which all other machines and all metal war equipment are made." He pointed out that production of ball bearings at Schweinfurt accounted for 70 per cent of all German output and, after discussion, it was agreed that the pattern of use for ball bearings in this country could probably be applied to Germany. The problem of stocks of ball bearings was discussed, it being tentatively concluded that they were not large. He next pointed out that the Zeiss plant at Jena and the Leitz plant at Wetzlar accounted for 80 per cent of optical glass and precision measuring instruments. Precision instruments were used to an important extent throughout industry and optical products were of course essential to bomb sights, range finders and periscopes. With respect to grinding wheels, Mr. Oberg estimated

that four plants accounted for 60 per cent of requirements. Grinding was shown to be an essential operation in all forms of metal work, particularly in the production of precision war materials. The grinding operation constituted an important part of the manufacture of ball bearings themselves. Grinding wheels wore out rapidly and were required in thousands of types and sizes. The most vulnerable features of a grinding wheel plant would be the kilns where the wheels were baked. The manufacture of abrasive grains was next discussed. The most vulnerable feature of this operation was said to be the electric furnaces. With respect to machine tools themselves, Mr. Oberg suggested dividing the industry into particular types, such as turret lathes, automotive turning machines and screw machines and then concentrating on one type. Machine tools would become particularly important only after the destruction of an industry or in the process of building up production.

The subcommittee on non-ferrous metals stated that three metals, aluminum, zinc and copper, should be considered together because they were more or less interchangeable. An important source of copper was the Bor Mine in Jugoslavia which produced 100,000 tons annually. Total production within the Axis was estimated at 250,000 tons, including 70,000 tons from scrap; stock piles were non-existent and demand was estimated to be in excess of supply. Copper, however, did not offer any target other than the Bor Mine. Only high-grade zinc needed to be considered because that was the only kind that could be used in the making of brass. Brass, in turn, was important in the manufacture of ammunition and in ship construction. Five plants in Western Axis were believed to account for 75 per cent of high-grade zinc production. In the case of aluminum, it was felt that six alumina plants accounting for 67 per cent of production were the prime targets. The production of alumina was an essential first step in the production of aluminum. Germany had for many years been making extensive use of aluminum in its economy. This involved use of

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this metal for many purposes for which copper was used in other countries. The question was raised as to the immediacy of effect upon the war effort of the destruction of alumina plants. On this point, views were expressed that there were a number of industrial uses which might be curtailed and that stocks in the hands of consumers might be substantial.

The subcommittee on transportation reported that it was not feasible to deprive the Axis of Rumanian oil through attack on transportation targets because of the multiplicity of the targets involved and the relative ease of their repair. The Committee discounted reports of the German transportation system being on the verge of collapse. The effect of the possibility of attacking inland waterways, particularly through ship elevators and aqueducts was covered but at no point did the transportation system appear to offer a field of objectives within the scope of any projected operating air force.

On 15 January 1943, the Committee met for the purpose of receiving reports on aircraft, coke, oil, chemicals, iron and steel, food and motor vehicles. The subcommittee on aircraft had prepared an assembly schedule giving times between manufacture and delivery of the several components and their incorporation into a finished aircraft. From this schedule, it was possible to determine the effect of destruction of any given segment of the process. It was suggested that attack on this industry might be directed against aircraft assembly plants, engine assembly plants, component manufacturers or a combination of the three. The more vulnerable features of a final assembly plant were the jigs; in the case of engine assembly plants, they were the component erecting shops and the testing beds. It appeared that aerial photographs of recent date of the principal objectives were unobtainable in the United States. Differences in enemy strength figures were accounted for by differences in calculating methods between the British and ourselves.

The British estimated operational strength by squadrons. Initial fighter squadron equipment, for example, was nine aircraft, with three more in immediate reserve. The British would not always take reserve aircraft into consideration because, from their experience, they did not believe that they in fact existed. G-2, on the other hand, took the British figures as to number of squadrons and added 30 per cent for reserves.

A-2 followed the G-2 procedure. The fact that Germany's aircraft production was not higher than estimated was explained by lack of skilled manpower. An additional reason was that Germany was shifting over to production of a new type fighter, the FW 190. Production of BMW engines for this type aircraft was tight and it would take considerable time to convert facilities to their manufacture. A discussion followed as to whether bombing of aircraft engine plants, in addition to assembly plants, would not be redundant.

The coke report indicated that the minimum requirements for furnace grade coke represented on 26 per cent of maximum output. There was considerable discussion of the vulnerability of coke ovens, principally by Messrs. Powell and Mac Arthur. A model of a coke oven was used by Mr. MacArthur to illustrate <sup>4</sup> points. It was stated that a direct hit would put a whole battery out of commission and that a very severe shock would throw the bricks out of line and cause great damage, probably necessitating rebuilding. Coke batteries were easily recognizable from the air. In the Ruhr area which accounted for 52 per cent of total capacity, there were 329 batteries in 99 separate plants.

In connection with the petroleum report, the point was made that Mr. Hamilton, Colonel Leach and the writer had proceeded to New York to interview various experts of the Standard Oil Company of New Jersey on several technical matters upon which the experts disagreed. Mr. Russell, Vice President of the Standard Oil Development Company, had

arranged for these experts to be present and the greater part of a day had been consumed in discussing and ironing out differences of opinion. The subcommittee stated that synthetic production would increase by approximately two million tons during 1943 because of the completion, during the middle of the year, of two large synthetic plants, one at Brux and the other at Blechhammer. There was a question as to whether observed expansion at Leuna was for the production of synthetic petroleum or synthetic rubber. The Standard Oil people believed it was for the latter. Crude oil production for 1943 and 1944 was estimated at approximately 10 million tons per annum. Requirements were figured at 16 million tons, of which 9 million were for direct military uses. Stocks on hand had to be broken down between mobile and immobile stocks. Mobile stocks were estimated at 2.1 million tons and immobile stocks at 2.0 million tons. Discussion then turned on the effect upon aviation gasoline of the destruction of 15 Bergius hydrogenation plants. Production of green grade aviation gasoline required a compression of 700 atmospheres, whereas the blue grade could be made at a compression of 300 atmospheres. Not all the Bergius plants were equipped to make the green grade. In the event of their destruction, it would be possible to make aviation grades of gasoline by mixing toluol with base stocks. The most vulnerable features of synthetic petroleum plants were the compressors and it was thought it would take at least nine months to replace them if damaged. The Rumanian refineries represented the most concentrated target in the crude oil system. If they were destroyed, the transportation of Rumanian oil elsewhere in Europe for refining would be a severe burden on the Axis. The principal stand-by refining capacity was in Italy, Southern France and Northwestern Germany. The chemical report turned on a discussion of propellants. Sixteen

nitrates plants were believed to represent a possible target system.

Of these, three, representing 20 per cent of capacity, were in Silesia.

They were believed highly vulnerable because of their inflammable character and it was estimated that reconstruction would take between six and eight months.

The report on steel brought out the fact that capacity to produce steel totaled 52 million tons against production of 41 million tons.

Emphasis was placed on ferro-alloys. Nine plants accounted for 80 per cent of ferro-silicon. The electric furnaces in these plants were the vulnerable features. The question of whether substitutes for ferro-silicon could be obtained was raised but was not finally answered.

The report on food did not develop any new material other than that 36 nitrogen plants accounted for 81 per cent of Axis capacity and that one plant accounted for 30 per cent.

In the motor vehicle report, the possibilities of attacking crank-shaft production, fuel injection parts and ball bearings were discussed.

#### VIII. THE TRIP UNDERTAKEN BY REPRESENTATIVES OF THE COMMITTEE TO GREAT BRITAIN AND THE RESULTS ACHIEVED THERE

The study had now arrived at a point where all material available in the United States had been collected and analyzed and, although the final reports of the subcommittees were not completed, a pattern of attack clearly had emerged. Before undertaking to submit a final report, it was decided that representatives of the Committee should proceed to Great Britain for the purpose of checking and supplementing their material with sources in that country.

The question as to who should compose the membership of the group was debated at some length and it was finally decided that the mission should consist of Messrs. Root, Lamont and Hamilton, Colonel Leach and the writer.

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At this very time, however, the Secretary of War and the Assistant Secretary of War for Air raised objections to the participation of either Mr. Lamont or Mr. Root. Both Mr. Lamont and Mr. Root felt that the reasons advanced for this decision were not persuasive. Mr. Root obtained an interview with the Secretary of War, at which Mr. Lovett was present. The subject of AWPD 1942 was raised and Mr. Root pointed out why it did not meet the issue now raised. When the Secretary had been acquainted with the nature of the Committee's work and the progress made to date, he indicated his complete approval. General Arnold was at the Casablanca conference. In his absence, General Gates took the position that the members selected should go to Great Britain as agents of General Arnold without any outside interference. As Mr. Lamont's health was not of the best, however, it was decided that he had better not undertake the trip. The difficulties described made it impossible for Mr. Root to leave with the rest of the group but matters were cleared up so that he did in fact arrive in England some ten days after the other members of the Committee.

A conference was held by Dr. Earle, Mr. Lamont, Colonel Leach and the writer with Mr. Hall in which the progress to date was outlined. Mr. Hall agreed to inform authorities in Great Britain of the trip and to facilitate contacts there. Dr. Earle wrote directly to Mr. <sup>Winfred</sup> Rieffler, head of the Economic Warfare Division of the American Embassy and a former colleague at Princeton, to the same effect. A copy of Dr. Earle's letter is attached (Tab J).

Mr. Hamilton, Colonel Leach and the writer departed from New York via American Export Airlines on 22 January, arriving in Bermuda the same afternoon. The next morning at 10 o'clock they left Bermuda and arrived at Foynes at 7 o'clock the morning of 24 January. Weather conditions at Foynes were not good and, in addition, there were numerous individuals

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holding a higher priority for the trip to England. Accordingly, two days were spent in Ireland. The third day, the members flew as far as Poole where, unfortunately, an air raid alarm made it necessary for the ship to turn back to Ireland. Finally, on 26 January, the members arrived in London. They were met by certain colleagues of Mr. Hamilton's who had arranged for quarters at Charidges Hotel. Upon arrival at the hotel, they were met by Mr. John Marshall Harlan. <sup>from</sup> Mr. Harlan's first remarks, it was obvious that such advance information as to the Committee's work and projected trip as had reached England had resulted in certain misconceptions among authorities there with respect to both the Committee's methods and purpose. This view was confirmed the same evening at a meeting with Mr. Riefler. It appeared, during the course of the conversation, that, in the summer of 1942, there had been set up, under Mr. Riefler, an organization known as the Enemy Objectives Unit staffed by members of the Office of Strategic Services and Board of Economic Warfare. The chief of this division was Mr. Chandler Morse. The circumstances under which the division was created were that Colonel Berliner, Assistant Chief of Staff, Plans, Eighth Air Force, believed it advisable for target information matters to be handled in England rather than by A-2 in Washington. It was through his efforts that a group of young economists had been furnished by the two agencies mentioned. Mr. Riefler was informed as to the general approach undertaken by the Committee. It was apparent that Mr. Riefler believed (a) that the work of the Committee should be handled in London for security and other reasons and (b) that it had already been successfully undertaken there. There was some reason to believe that Colonel Berliner held similar views.

It further appeared that General Sorensen had written a letter to General Kuter, outlining his conceptions of the scope of the Committee's activities. This letter had found its way through channels to General Eaker. There were intangible grounds indicating that the reaction both to General Sorensen's and to Dr. Earle's letters had not been entirely as anticipated by them. ✓

The following day Colonel Leach and the writer proceeded to General Eaker's headquarters to report to him. Upon arrival, they met Colonel Lucius P. Ordway, Assistant Chief of Staff, A-2, who informed them that their reception would probably prove decidedly cool. This, however, did not prove to be the case. General Eaker was extremely courteous. He first inquired as to the nature of the Committee's work and, after the writer had explained it to him at some length, stressing that the Committee's conclusions were tentative and that the purpose of the mission was to check economic data against sources in the United Kingdom and to obtain the views of responsible officers of the Eighth Air Force as to the general feasibility of the program and as to the probabilities and trends affecting the time of its performance, General Eaker stated that from such advance notice as he had had of the Committee's activities he had some misgivings but that "now that I see your attitude, I will be only too glad to cooperate in every way". He added that he desired all relevant material in the possession of the Eighth Air Force to be made available and stated that he would make arrangements for the same to be obtained from British sources. A memorandum of what occurred at this meeting was prepared the same day and is attached (Tab 11). As Colonel Berliner was out of town, participating in a raid, a conference was held with Colonel Hughes and arrangements were made to return the next day.

On the following morning, therefore, Mr. Hamilton, Colonel Leach and the writer brought their material to Colonel Berliner's office where Colonel Berliner, Colonel Hughes and other members of the Plans section sat down with them to compare notes. The petroleum industry was selected as a point of departure. It appeared that the Committee's information was accurate so far as that in the possession of the Eighth Air Force went; that the Committee had certain sources of information, particularly with respect to aviation gasoline, which did not exist in Great Britain and that the Committee's tentative selection of targets could be upheld. There was some feeling upon the part of the Eighth Air Force that Fischer-Tropsch plants should be included in any petroleum target system. In the case of aircraft, it appeared that more detailed and recent information existed in Great Britain, particularly in the Air Ministry. The Committee's conclusions as to the method of attacking the industry, however, appeared sound. Colonel Berliner favored attack on fighter aircraft assembly plants over fighter engine assembly plants because of their quicker effect. Various other reports were discussed. It appeared that the ball bearing industry was one which was viewed favorably as a target but that no work had been undertaken at all on abrasives. It was clear that such material as existed in Great Britain had not been organized in the manner and from the point of view of the subcommittee studies. In general, it could be said that, so far as material in the possession of the Eighth Air Force was concerned, there was nothing with respect to any industry which the Committee did not have, other than as to the aircraft industry; the Committee had had opportunity to survey several fields which had not been surveyed by the Eighth Air Force.

The members of the Committee desired to compare their material with British officials. Considerable opposition developed to this or to any

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contacts between members of the Committee and British officials, the grounds being (a) that there were serious problems of security, (b) that the British officials had been so harassed by the recurring necessity of discussing all kinds of problems with many visiting officers and officials that all contacts with them should be kept to a minimum and (c) that the proper function of the Committee was not to ask questions but to submit all relevant specific data in its possession. It was finally agreed that the members would reduce their questions to writing, that these would be submitted by Colonel Berliner to the British authorities and that arrangements might be worked out for members of the Committee to visit these officials in the company of Colonel Berliner and Colonel Hughes.

Colonel Berliner pointed out that basic economic studies required by the Eighth Air Force were handled by the Enemy Objectives Unit of the American Embassy and it was determined that the Committee's material should next be compared with that in the possession of this division. An interview was held accordingly the next day with Mr. Chandler Morse and his assistants, in the presence of Colonel Berliner. It was apparent that such material as the Enemy Objectives Unit had accumulated had not, possibly for lack of time, been completely organized; but that several studies with respect to various industries had been made and that a rough idea of certain primary targets had been outlined. As Mr. Morse did not appear desirous of furnishing the Committee with his material, the members undertook to receive his criticisms of their studies and to prepare written questions for reference to appropriate British sources.

A memorandum of this conference was prepared and is attached (Tab 12). The preparation of the written questions took some 48 hours. They were then turned in to Colonel Berliner and were forwarded by him, in part, to the Air Ministry and, in part, to the Ministry of Economic Warfare.

As the members of the Committee stated that it was essential for them to personally interview the individuals who would prepare the answers, Colonel Berliner arranged for interviews, first with Squadron Leader Allom and Wing Commander Burgess of the Air Ministry and, subsequently, in conjunction with Mr. Morse, with Mr. Lawrence of the Ministry of Economic Warfare.

Squadron Leader Allom had gathered together all his material on aircraft and engine production. His figures were the most accurate available anywhere and differed in some degree from those available in Washington. Both Squadron Leader Allom and Wing Commander Burgess appeared perfectly ready to discuss the problem without reference to any limitations whatever. Consequently, the course of the conversation tended to develop the broader aspects of the problem and the members of the Committee ended up by obtaining a greater degree of information than was strictly called for in the answers to the written questions. The same was true of the interview with Mr. Lawrence. Memoranda of the conferences with the Air Ministry and the Ministry of Economic Warfare were prepared and are attached (Tabs 13 and 14). Copies of the questions submitted to Colonel Berliner by members of the Committee are attached (Tab 15).

As the work of the members proceeded, it became increasingly evident that one of the possible sources of friction was the work of the subcommittee on probabilities. This subcommittee was attempting to deal with a solution to operational problems which individuals on the spot quite properly felt only they were qualified to answer. The members explained that, in their view, the work of the subcommittee on probabilities did not necessarily form the cornerstone to the study. Any standard of force required arrived at, however inaccurately, could be applied to each industry to determine the force required to destroy it relative to that required for any other industry. From these calculations, a selection of targets which were not ~~economically~~ desirable but feasible of destruction determination of operational factors - such as could be arrived at. The t

accuracy, attrition, weather and enemy resistance - was something which might later be worked out by the operating authorities in Great Britain. It was true that this would make it difficult to reply directly to the question contained in General Arnold's directive. On the other hand, if a target system could be evolved on a sound economic basis which would also meet the approval of the operating authorities, the result would be of maximum value to all concerned.

On January 30, 1943, the members of the Committee submitted a memorandum to General Eaker (Tab 16), outlining the progress to date. General Eaker replied under date of February 3, 1943 (Tab 17).

As the days went by, the constant contacts maintained with the Eighth Air Force and the Enemy Objectives Unit resulted in a considerable clearing of the atmosphere. The members of the Committee stressed the fact that they were desirous of submitting a report which would be both helpful and agreeable to the Eighth Air Force and that they did not believe the Committee would undertake in its report to deal with either operational factors which were peculiarly within the province of the Eighth Air Force or with a system of target selection which would "get all around Washington". The meetings, in fact, produced an atmosphere of cordiality and it became apparent that the target pattern which had emerged from the Committee's studies was sound. There it was, in fact, questionable, in view of the apparent agreement of views whether, for reasons of security, it would not be best to submit a purely formal report which would not list targets by order of priority. It was reasoned that since the Eighth Air Force was aware of and agreed with the Committee's conclusions, perhaps the most important element of the Committee's task had been achieved. There was no reason to feel that the Committee's views were in conflict with those of British authorities.

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The writer and Colonel Leach conferred with General Eaker and Colonel Berliner on February 1 and again on February 4. The latter meeting was devoted primarily to operational questions. General Eaker had kindly arranged for Brigadier General Longfellow, Commanding General of the Eighth Bomber Command and his Assistant Chief of Staff for Operations to be present. It was pointed out that the radius of heavy bombardment aircraft at the time was not in excess of 400 miles; that crews arriving in the theatre required at least a month's training; and that it would be possible to maintain 70 per cent of the aircraft in the theatre operational. It was essential to saturate the defense by dispatching forces of not less than 300 aircraft. General Eaker believed that any calculations based on circular error of probability were valueless and "not worth the paper they were written on". Such calculations might hold in the case of practice bombing where the total number of hits could be counted but this could not be done in combat. It was expected that bombing accuracy would improve and that weather conditions would permit an average of six missions per month during the period November-March and ten missions per month during the period April-October. It was felt that German anti-aircraft defenses required that attacks be delivered from heights of not less than 25,000 feet. Nevertheless, the greatest losses would be occasioned by fighter opposition. Losses would decrease in proportion to the numbers sent. In the case of 100 bombers, a figure of 5 per cent might be used. This could be reduced to 3 per cent in the case of 300 and to a negligible figure in the case of 1000. A memorandum of this conversation, prepared the same day, is attached (Tab 1B).

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Mr. Root arrived in London on 4 February 1943, at which time the mission had progressed to a point where it was felt that the original members could return. However, Mr. Root had a long interview with General Eaker and with Air Marshal Harris, Commander of the RAF Bomber Command, in which the Committee's work was again reviewed. Although Air Marshal Harris was a proponent of area attack, he believed that precision bombing would have important complementary effects.

The members of the Committee, other than Mr. Root, left England on 7 February and after some delay due to bad weather arrived in Washington on 18 February. Mr. Root followed a few days later. ✓

#### II. PROGRESS IN WASHINGTON DURING THE MISSION TO GREAT BRITAIN

##### A. The Subcommittee on Abrasives

Before members of the Committee left for England, arrangements had been made to expand the study on machine tools to include a more detailed account of the abrasives industry. Dr. Samuel Ross of the War Production Board was made available by Mr. Batt for this purpose. During the period while the members of the Committee were in England, Dr. Ross visited officials of the Norton Company and the Carborundum Company, the two largest American manufacturers of abrasives and grinding wheels. His conclusions were incorporated in Mr. Oberg's final report on machine tools.

The subject of abrasives was one upon which differences of opinion existed. At the meeting in London, at which the industry was reviewed, Mr. Morse produced a document signed by one Isaiah Frank of the Office of Strategic Services, a copy of which is attached (Tab 19). Although this document bore on its face a notation that it was an interoffice memorandum and although it had been prepared in connection with the Committee's study, it had been forwarded to the Enemy Objectives Unit in London without the knowledge of the Committee. This paper which purported to be the result of interviews with several smaller grinding

wheel manufacturers and which set forth several technical reasons why the industry was not a good bombardment objective, was used by Mr. Morse to fortify his objections to the industry. The members of the Committee were, under the circumstances, at some disadvantage in preparing any immediate rebuttal to Mr. Morse. On their return, therefore, they adopted a more conservative view of the possibilities of this target system than had the members of the subcommittee. In the Committee's final report, abrasives and grinding wheels were placed fourth in order of priority. As will subsequently appear, in the final plan prepared by the Eighth Air Force and known as the "Combined Bomber Offensive", abrasive targets were not included. This led to a lengthy and interesting study which resulted in a re-evaluation of the abrasives industry by the Eighth Air Force and the Ministry of Economic Warfare and all other economic authorities in accordance with the high priority given it by the Committee. The details with respect to this study are treated at length hereinafter.

B. The Subcommittee on Submarines

The subject of submarines and the best method of attacking them through the use of air power was considered by the Committee at the outset of its study. It was felt that it would be desirable for the Navy to be represented on any subcommittee study on this subject. General Fairchild contacted various individuals in the Navy who, as individuals, expressed approval of the Navy joining in such a study. However, formal departmental approval was not obtained and it was determined, therefore, that the study would have to be undertaken without direct participation by the Navy.

A subcommittee was appointed under the chairmanship of Lt. Colonel (then Major) Grinnell Martin of A-2, the other members being Mr. Frank J. Mannheim of the Office of Strategic Services and Mr. Benjamin L. Webster of A-2. This subcommittee prepared a lengthy report advocating

attacks upon submarine building yards and submarine operating bases.

Several members of the Committee had been skeptical from the outset of the effects of attacks upon either submarine building yards or operating bases. The Eighth Air Force had been engaged during the fall of 1942 in numerous attacks upon the latter but the effects upon submarine activity were questionable. The members of the Committee who went to England obtained considerable information of interest with respect to this problem. Under date of 16 January 1943, the Plans Section of the Eighth Air Force had prepared a survey of the air effort against submarines to date (Tab 20). This survey pointed out that attacks on submarine components would have a long-term effect and, because of this fact, plus the existence of excess productive capacity, attack on this system could not be recommended. Attacks on submarine building yards, even if they were effective, would not decrease the number of submarines operating in the Atlantic within a year. The operating bases in the Bay of Biscay seemed to be the most profitable targets, despite the fact that the massive concrete pens erected there could not be penetrated by any bombs available.

Sentiment in the Eighth Air Force itself, as well as in the confines of the Air Ministry, was against continuing attacks on the bases. Losses were increasing for the enemy was able to concentrate his defenses and the possibilities of surprise were relatively non-existent. On the other hand, the Admiralty, which was much disturbed by the submarine menace, was exerting its influence for a continuation of the attacks.

Sir Dudley Pound's letter to General Eaker of 23 November 1942 (Appendix B to Tab 20) was indicative of this viewpoint.

At the Casablanca conferences, the subject of submarines had figured prominently and it was apparent that General Eaker did not believe any air offensive plan which did not give attack on submarines high priority would be adopted by the Combined Chiefs of Staff. In

the Committee's final report, nevertheless, attack on submarines was given a low priority rating. The Committee doubted the effectiveness of bombing submarine bases. Building yards, despite the length of time before the effects would be noticeable and despite their rapid recuperability, were deemed the most likely targets.

C. The Subcommittee on Rubber

Under the direction of Mr. Page, the Rubber subcommittee was enlarged to include representatives of the Rubber Reserve Corporation. The whole subject was reviewed and a new report was submitted, in which attack on synthetic rubber production and on rubber tires, particularly for aircraft, was recommended.

X. THE PREPARATION OF THE COMMITTEE'S FINAL REPORT

Upon the return of the members to Washington, the preparation of a final report was immediately undertaken. There appeared to be no significant differences of opinion within the Committee as to the priority of the various industrial systems but there was considerable discussion as to the manner in which the report should be orientated. The members who had been to England argued for the submission of a document which would (a) leave out all reference to the subcommittee on probabilities, (b) not openly rate target systems by order of priority, (c) give the greatest latitude to the operating authorities in England. After considerable debate, this viewpoint was finally adopted. A drafting committee, consisting of Mr. Hamilton, Colonel Leach and the writer, was appointed. The drafting committee presented several versions of a report in the preparation of which they were assisted by Mr. Root, Mr. Lamont and Dr. Earle. The principal conclusions were:

1. It is better to cause a high degree of destruction in a few really essential industries or services than to cause a small degree of destruction in many industries. Results are cumulative and the plan once adopted should be adhered to with relentless determination. In the determination of target

priorities, there should be considered (a) the indispensability of the product to the enemy war economy; (b) the enemy position as to current production, capacity for production and stocks on hand; (c) the enemy requirements for the product for various degrees of activity; (d) the possibilities of substitution for the product; (e) the number, distribution and vulnerability of vital installations; (f) the recuperative possibilities of the industry; (g) the time lag between the destruction of installations and the desired effect upon the enemy effort.

2. The destruction and continued neutralization of some sixty targets would gravely impair and might paralyze the Western Axis war effort. There are several combinations of targets from among the industries studied which might achieve this result.
3. In view of the ability of adequate and properly utilized air power to impair the industrial sources of the enemy's military strength, only the most vital considerations should be permitted to delay or divert the application of an adequate air striking force to this task.

As originally signed, the report contained the following paragraph:

"By way of concrete example, it is felt that if a force of 500 heavy bombers, of loaded range equal to the latest B-17, could be maintained continuously in the Eighth Air Force, free for the bombing of industrial targets for a period of eight months, the effect would be to impair very gravely the capacity of the Western Axis to resist; and, if a force of 1,000 such planes could be maintained, equally free for a similar period, the result might well be to cripple the Western Axis war effort."

The signed report was shown to General Fairchild before its submission to General Arnold. General Fairchild indicated that it would be best for the paragraph above quoted to be deleted. As the matter did not appear of extraordinary consequence, the deletion was made in the report submitted to General Arnold by rephotostating the last page so as to omit it. Subsequently, at General Sorensen's insistence, the Committee voted formally that the paragraph be omitted and formal permission to omit it was granted by General Arnold under date of 25 March 1943 (Tab 21).

The Committee's report, as finally drafted, consisted of a general statement, copy of which is attached (Tab 22) and appraisals of each industrial target system. These target systems, although not rated formally in order of priority were nevertheless inserted in the report in that order. The priority established for the various industrial systems was:

1. Fighter aircraft
2. Ball bearings
3. Petroleum
4. Abrasives
5. Non-ferrous metals
6. Rubber and tires
7. Submarine Construction Yards and Bases
8. Military transport vehicles
9. Transportation
10. Coking plants
11. Iron and steel
12. Machine tools
13. Electric power
14. Electrical equipment
15. Optical precision instruments
16. Chemicals
17. Food
18. Nitrogen
19. Anti-aircraft and anti-tank artillery.

The name adopted by the Committee, on the presentation of its report, was "Committee of Operations Analysts".

## II. PROCEEDINGS SUBSEQUENT TO THE SUBMISSION OF THE COMMITTEE'S REPORT

Upon its submission, General Arnold turned the report over to Colonel Cabell and Colonel Smart of his Advisory Council for their criticisms. These officers reported favorably upon it. On March 25, General Arnold received General Gates, Mr. Root, Mr. Lamont, Colonel Leach and the writer. There were also present the Chief of the Air Staff, General Stratemeyer, and Colonels Cabell and Smart. General Arnold stated that he was highly pleased with the report; that he was directing Colonel Cabell to immediately proceed with it to England for the purpose of implementing it there and that he desired the Committee to undertake similar studies, first, with respect to Italy and, then, with respect to Japan. He read a directive dated March 23, 1943, to this effect, a copy

of which is attached (Tab 23).

Colonel Gabell departed for England the next day. Upon his arrival, a committee was formed, consisting of representatives of the Eighth Air Force (General Hansell), the Royal Air Force, the Air Ministry and the Ministry of Economic Warfare. The Committee's report, together with the underlying subcommittee reports, was considered by this committee and a plan for the strategic bombardment of Western Axis was formulated.

The plan followed the Committee's report except for the omission of the abrasives industry and the inclusion of attacks on submarine construction facilities. As previously stated, attacks on submarine construction had not been strongly advocated by the Committee; it was felt apparently that no plan which omitted submarines would obtain the approval of the high command. The elimination of abrasives was due to opposition from the Enemy Objectives Unit of the American Embassy and the Ministry of Economic Warfare based on the allegedly high recuperability of the industry.

The Committee's report was warmly received in England as is indicated by the following comments:

By the committee appointed to review it:

"The Report of the Committee of Operations Analysts is eminently sound. It is a magnificent piece of work. A careful review of it indicates that its conclusions coincide with the facts available to us, and with all information available to the RAF and the Air Ministry, which was freely placed at our disposal."

By Sir Charles Portal:

"As you know, the Eighth Air Force has been engaged with the Air Staff in drawing up a detailed plan for the purpose of discharging the responsibilities laid upon our combined bomber forces at the Casablanca conference.

"The plan is now complete. It is based on our combined resources in the matter of intelligence and operational data including the very valuable report of your Operations Analysts and has been drawn up in close consultation with the MEW.

"I have carefully examined the plan and discussed it in all its aspects with the Commanding General, Eighth Air Force. I take this opportunity of saying that I believe it to be entirely sound and that it has my full support.

".....For all these reasons, I earnestly hope that every effort will be made to achieve and if possible to exceed the programme.

"The plan has been carefully examined by the Commander in Chief, Bomber Command, and he too is convinced of its soundness and importance."

General Eaker flew to Washington where he presented the plan directly to the Joint Chiefs of Staff and to the Combined Chiefs of Staff who approved it on 18 May 1943. The approved plan was known as the "Combined Bomber Offensive". The absence of any opposition on what had theretofore been a highly controversial issue, the lack of red tape in its presentation and the speed with which it was adopted by the high command were epochal. The months of preparation had at last borne fruit.

At the Casablanca conference, the role of the air forces in the war against Western Axis had been defined as follows:

"To conduct a joint U.S.-British air offensive to accomplish the progressive destruction and dislocation of the German industrial and economic systems and the weakening of the morale of the German people to a point where their capacity for armed resistance is fatally reduced."

The Combined Bomber Offensive became, therefore, the authoritative method of fulfilling the mission of air power as defined in the Casablanca directive.

With this plan, the concept of strategic air power for the first time received concrete approval in the highest quarters. Advocates of air power had long contended that aircraft alone could win a war. General Mitchell had argued for the supremacy of the air arm. General Douhet had claimed that mass attacks upon cities would bring a nation to its knees. The studies of the Air Corps Tactical School had pointed the way to the selection of a limited number of industrial targets as the key. Neither the Germans nor the British, however, had been able to achieve the results envisioned by Douhet. Both lacked the types and numbers of aircraft necessary and neither had chosen to concentrate their existing forces on a limited number of crucial industrial targets.

The Battle of Britain had been, in substance, an attack on the morale of the British although docks, transportation and certain important industrial establishments had been singled out. Though it had not

succeeded, the British admitted readily that had it continued for even a few weeks more, Great Britain's power to resist invasion would have been undermined.

British air attacks on Germany, for lack of ability to obtain precision results, had assumed the character of mass destruction of industrial areas. The results of such attacks were partly psychological and partly economic. Although <sup>the</sup> more important of these areas had been carefully analyzed as a basis of what was referred to as the "Bombers Baedeker", no attempt had been made to pick out bottlenecks in the economy whose destruction would have the most rapid and pervasive effect upon German powers of resistance.

With the adoption of the Combined Bomber Offensive Plan, therefore, it could be said that a new era in warfare had commenced.

XII. THE CIRCUMSTANCES SURROUNDING THE PREPARATION OF THE SUPPLEMENTARY REPORT OF THE COMMITTEE ON WESTERN AXIS ABRASIVES.

As has been previously stated, the abrasive and grinding wheel industry had not been incorporated in the Combined Bomber Offensive plan because of objections on the part of the Enemy Objectives Unit of the American Embassy and on the part of the Ministry of Economic Warfare.

The report of the subcommittee on the abrasive and machine tool industry, submitted to the Committee of Operations Analysts on 13 February 1943 had advocated attack on four abrasive grain producers and six manufacturers of grinding wheels comprising 52.9 per cent and 51.3 per cent of Western Axis capacity, respectively. The basis for the recommendation was (a) abrasives and grinding wheels are essential to every form of modern precision manufacture, (b) production is concentrated, (c) stocks are low, (d) the plants are vulnerable to air attack, (e) substitution is impracticable, (f) recuperation would not be immediate.

As of 1 February 1943, the officers of the Eighth Air Force had not made a detailed investigation of either abrasives or grinding wheels.

The Enemy Objectives Unit of the American Embassy expressed the opinion at that time that (a) stocks were adequate, (b) the plants were not particularly vulnerable to air attack, (c) if the kilns at grinding wheel plants were destroyed, pottery and enamel ware kilns could be used, (d) puddled wheels could be substituted for controlled structure wheels if the presses were destroyed, (e) periodic kilns could be rapidly constructed to take the place of destroyed tunnel kilns, (f) there was no prospect of early effect upon general industrial production and on front-line strength. In support of this position, there had been produced the inter-office memorandum from Mr. Isaiah Frank of the Office of Strategic Services to Mr. Sidney S. Alexander of said office, dated 22 January 1943 (Tab 19). This memorandum was reputedly based on conversations with technical men in smaller grinding wheel plants and

concluded that "grinding wheel plants do not constitute profitable targets because, with the exception of hydraulic presses, the major apparatus can be constructed in about a month". The inference from the memorandum was that the larger manufacturers, Norton Company and Carborundum Company, had been led astray in their statements to Dr. Ross of the subcommittee on abrasives by their long habit of producing wheels by the most modern and economical methods, whereas the smaller companies knew what expedients could be adopted to maintain production in an emergency even though at some cost of manpower and money.

On 2 February 1943, representatives of the Committee had conferred with Mr. Oliver Lawrence of the Ministry of Economic Warfare who had stated (a) that grinding wheel plants would appear a better target than abrasive producers, (b) that the sources of information with respect to grinding wheels in the U.K. were not as good as in the U.S., (c) that he had no detailed information as to the concentration of the industry of the industry or of its recuperative powers other than that he would expect the kilns to be easy to replace.

On 12 February 1943, Mr. Lawrence had addressed a memorandum to Mr. Morse of the Enemy Objectives Unit (Tab 24) dismissing attack on abrasive grain producers and stating that "opinion in industry in this country confirms strongly that the firing of wheels can be done with very little inconvenience in pottery kilns should the grinding wheel makers' own kilns be put out of action.

In its report of March, 1943, the Committee of Operations Analysts had concluded as follows with respect to the industries in question:

#### \*GRINDING WHEELS

"Grinding wheels are essential to the manufacture of innumerable metallic parts for war materiel and the small tolerances required therein necessitate the use of grinding wheels of high precision. Grinding wheels are rapidly consumed, their frequent replacement is

necessary in many basic operations, and no substitute for them has been devised. It is believed that the destruction of 50% of Axis grinding wheel production would affect manufacture of war materials within one month and that the effect, provided no remedial measures were adopted, would become decidedly serious at the end of three months. Recuperation could be expected to take place beginning in six weeks unless further attack on the industry were undertaken.

"The kilns, presses and truing machinery are vulnerable installations. American experience, under wartime conditions, indicates the difficulty of building up substantial stocks and the diversity of sizes and types has, in peace time, led to a similar result. Despite the possibility of cannibalization, it is not believed that stocks within the Western Axis would exceed a six-week reserve for normal operations. It cannot be foreseen what particular industries would be affected by destruction of any particular plant or series of plants but the dislocation would tend to spread over the entire German war industry. Adaptation of remaining plants to manufacture of types of wheels previously made in destroyed plants would be a six weeks' process.

#### CRUDE ABRASIVES

"The difficulties caused by the destruction of the plants making Grinding Wheels would be enhanced by attack on the abrasive industry through the destruction of 4 plants producing crude abrasives. It is believed that the relative invulnerability and recuperability of crude abrasive plants makes them less attractive targets than the grinding wheel manufacturers."

A list of 10 targets was appended, six in the grinding wheel industry and four in the crude abrasive industry.

The position taken by the full Committee differed somewhat from that of the subcommittee in that considerably less emphasis was placed on attack on producers of abrasive grains.

The Committee's report, together with the subcommittee studies had been referred by General Arnold to the Commanding General, European Theatre of Operations and by the latter to a committee comprising representatives of the Eighth Air Force, the Royal Air Force and economic authorities in the United Kingdom.

On 3 April 1943 the Enemy Objectives Unit of the American Embassy had submitted a memorandum to Colonel Hughes (Tab 25) which raised four main points of disagreement with the original subcommittee report:

(1) a six week interruption of 50 per cent of grinding wheel manufacture would not be serious because stop-gap methods of production could be employed, (2) stocks were not low despite the thousands of sizes manufactured, (3) presses were not vulnerable, (4) periodic kilns might be readily substituted for tunnel kilns; a small lathe room for "truing" could be completely equipped in four or five weeks; porcelain and sanitary ware kilns could be substituted. On points (3) and (4), the authority of the OSS memorandum (Tab 19) was adduced.

At Colonel Cabell's suggestion upon his return from England, Colonel Leach and the writer undertook a review of the grinding wheel industry. Mr. Frank was first contacted. It developed, upon questioning, that Mr. Frank had never personally contacted the individuals referred to in the memorandum of 22 January (Tab 19) but had merely asked one of them certain questions over the telephone. Mr. Frank stated that his memorandum had never been intended to be used outside of his own office and that it did not necessarily represent his final views on the subject. This led to a trip to Philadelphia by Colonel Leach to interview officials of the Precision Grinding Wheel Company, the Abrasives Company and the General Grinding Wheel Company. It appeared that the Frank memorandum did not in any sense represent the considered views of the representatives of these companies and an affidavit to this effect was prepared (Tab 26). All three of the gentlemen interviewed were of the opinion that the grinding wheel industry and, more particularly, that segment of it producing precision grinding wheels was a target of the highest economic priority (Tab 27).

Interviews were subsequently held with officers of the Norton and Carborundum Companies in which satisfactory answers to the technical

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objections raised by the Enemy Objectives Unit and the British Ministry of Economic Warfare were obtained.

The original report of the subcommittee on Western Axis abrasives had stressed both the manufacture of abrasive grains and grinding wheels. The distinction between precision grinding wheels and other types of wheels, such as those produced by the puddled process, had not perhaps been sufficiently stressed. Nevertheless, the grinding wheel targets selected were in every instance plants in which precision grinding wheels were made and these plants accounted for the major production of precision wheels.

The Board of Economic Warfare was also requested to review the problem. In the process, two individuals were contacted: Dr. Oswald Basch, a German refugee who had for many years been president of Mayer & Schmidt one of the chief German grinding wheel manufacturers and Mr. C. J. Brockbank, Abrasives Director of the British Ministry of Supply who happened to be in the United States on a visit. These gentlemen were interviewed by Colonel Leach and the writer in conjunction with representatives of the Board. Both were firmly of the opinion that precision grinding wheels were essential to the production of all modern precision parts and that the industry deserved a high priority rating. Mr. Brockbank also favored attack on the manufacture of silicon carbide grain producers. Upon being confronted with the report of the British Ministry of Economic Warfare of 1 March 1943, he stated that he had not been consulted at any time during the course of its preparation.

Under date of 18 June 1943, Colonel Leach and the writer submitted to the Committee a report of their investigations (Tab 28). This included a detailed rebuttal of the arguments advanced by the Enemy Objectives Unit of the American Embassy under date of 3 April 1943 (Tab 25). It was this paper which had been chiefly instrumental in eliminating the industry from the Combined Bomber Offensive Plan. The various tabs

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referred to in the 18 June report to the Committee (Tab 28) are not attached hereto as they were incorporated in the final report of the Committee which forms part of this history.

Mr. Morse, who had been head of the Enemy Objectives Unit at the time the report of 3 April 1943 was submitted, had been transferred to Washington and participated in the Committee discussions on the subject. Considerable differences of opinion arose during the discussions. Mr. Morse was unwilling to modify his previous views drastically and the A-2 representatives, particularly Major Lowe, were hesitant about giving the industry a higher rating than it held in the Committee report. On the other hand, Mr. Root, Mr. Lamont, <sup>Col Leach & the writer</sup> and representatives of the Board of Economic Warfare (Mr. Hamilton was then temporarily on duty in London) were strongly in favor of giving the industry a very high degree of priority. This view finally prevailed. A report which did not materially differ from that originally submitted to the Committee for discussion was submitted to General Arnold under date of 26 June 1943. General Arnold directed Colonel Leach and the writer to proceed to England with the report and to submit it to General Eaker (Tab 29). General Fairchild also prepared a letter to General Eaker outlining his views with respect to the industry (Tab 30).

Colonel Leach and the writer arrived in London on 7 July. They immediately reported to General Eaker. General Eaker at first appeared to be under the impression that this was a new target system which would add to his existing burdens. However, it was pointed out to him that the Committee's view was that grinding wheels should supplant an industry, such as motor vehicles, which was lower in priority. It was further pointed out that the high vulnerability and small size of the grinding wheel targets made them particularly subject to attack by RAF Mosquito bombers. The fact that two of the principal targets lay beyond the operational range of the ~~Right~~ Air Force might be compensated for

either by the use of Mosquito bombers or by operations from Italian bases when available. In the absence of Colonel Berliner who had been seriously ill, Colonel Hughes was Acting Assistant Chief of Staff, A-5. Two copies of the study were presented to Colonel Hughes - one of which he forwarded to Air Commodore Bufton, Director of Bombardment Operations, Air Ministry, for review by the British and the other to the Enemy Objectives Unit of the American Embassy for review there. Numerous conferences were held with members of the Enemy Objectives Unit then under the immediate supervision of Mr. Hamilton and with Mr. Lawrence of the Ministry of Economic Warfare. As a result, Mr. Lawrence wholeheartedly changed his previous views (Tab 31). The objections of the Enemy Objectives Unit were also withdrawn. A summary of the conference in which this decision was reached is attached (Tab 32). Air Commodore Bufton's acquiescence is contained in a letter to the writer (Tab 33). In a letter to General Arnold, dated 31 July 1943, General Eaker stated that he endorsed the views of the Committee with respect to the grinding wheel industry (Tab 34).

Before returning to the United States, Colonel Leach and the writer proceeded to General Spaatz' Headquarters in North Africa. General Spaatz was then Commanding General, Northwest African Air Force which contained the heavy bombardment aircraft necessary for attacks from Italian bases on the grinding wheel targets in Czechoslovakia and at Dresden. The matter was reviewed first with Brigadier General Curtis, Chief of Staff, and with Colonel McDonald, Assistant Chief of Staff, A-2, both of whom expressed their interest and approval. It was then reviewed with General Spaatz who likewise indicated his approval.

### XIII. THE COMMITTEE'S REPORT ON ITALY

The Committee's directive of 23 March 1943 covered the submission of a report "analyzing the strategic targets in Italy, the destruction of which would knock Italy out of the war" (Tab 23).

The study on the Western Axis had covered industrial target systems as a whole, including those in Italy; the principal contribution of Italian installations to the Axis economy were shown. However, industries had not been segregated upon national or geographic lines.

The wording of the directive of 23 March led to considerable discussion within the Committee, but it was finally agreed that it should be interpreted as calling for a re-examination of the Italian economy to determine whether there existed any system of targets in Italy, the destruction of which would so damage the Italian economy that Italy would be forced to abandon the war even though Germany and the Axis satellites might still be able to continue. It was felt that the Committee's field of inquiry was limited to strategic bombardment. Italian transportation, for example, should be studied to determine whether attack thereon would seriously damage Italy's ability to supply the armed forces of the Axis rather than for the purpose of isolating areas which it was desired to invade.

It was apparent from the Committee's previous studies that, in the field of raw materials, Italy's only important contributions were mercury and manganese. The great bulk of Italian military production was devoted to the use of the Italian armed forces. Transportation, electric power and food supply appeared to constitute possible strategic bombardment objectives and it was decided that subcommittees in these fields should be set up. In addition, ~~explosives and munitions~~ special studies on Italian aircraft and munitions were instituted, together with an overall study of the relationship of Italy's industrial production to her war effort.

The report of the subcommittee on electric power indicated that Italian industry was heavily dependent upon electric power and that such power was, for the most part, generated hydraulically at considerable distances from the industrial regions. Eighty per cent of Italian industry was concentrated in northern Italy. The principal networks were divided into seven distinct electrical areas which, although interconnected, might be isolated through the destruction of 19 selected transformer switching stations, together with 5 generating stations and 4 generating stations and transformer substations.

In the case of transportation, it was pointed out that Italy's industrial production was largely dependent upon imports of raw materials over international railroad routes, that inventories of such materials did not, on the average, exceed one month's supply and that denial of these routes for a period of 30 days, which was the most that could be hoped for from any single air attack, would have no decisive effect although any further extended denial would be widely felt throughout the Italian economy. It was noted that the destruction of 11 bridges in northern Italy would completely stop all international routes; that central Italy could be cut off from the north by the immobilization of 5 other bridges; and that southern Italy could be isolated from the rest of the country by the destruction and continued immobilization of 6 bridges.

Italy's food position was deemed precarious although the effects of any attack on food would not be seriously felt until the fall of 1944. Attack on nitrogen plants and on 57 isolated pumping stations, whose existence was essential to the arability of some 850,000 acres of reclaimed farm land, was suggested. It was pointed out, however, that destruction of Italian food supplies might aggravate the supply problem in the event of a later occupation of Italian territory. The Committee's final conclusions were embodied in its report of 12 May 1943 as follows:

"The Committee's studies show that Italy not only makes no substantial economic contribution to the rest of the Axis but is on balance an economic liability. Certain geographic, political, and military advantages, however, accruing to Germany from the adherence of Italy, have, in the past explained her continued support of the Italian economy. This support mainly takes the form of supplies of raw or semi-finished materials to Italian industry. By processing such materials, in addition to those furnished by herself, Italian industry supports, in the main, her own army, navy, and civilian economy. The rate of production of military and naval equipment is small, both absolutely and in proportion to the amount on hand and, at the present low rate of Italian military activity, no quick results could be anticipated from even a complete interruption of Italian war production.

"The Committee has arrived at the following conclusions:

- "(1) The sustaining sources of the military effort of the Western Axis exist primarily in Germany.
- "(2) There are targets, mostly in Northern Italy, upon which an attack should be undertaken as part of a system of attacks by the Eighth Air Force upon other Western Axis targets in the same industry. Such attacks should be coordinated with the Eighth Air Force. These Italian industrial targets are shown in Chart I.
- "(3) The selection for strategic air attack of a pattern of industrial targets in Italy, independent of those in Chart I, would not reduce significantly the Western Axis war potential.

"In the event that it is desired to maintain general pressure on the Italian population, the fields of electric power, food and transportation are the most promising. A possible selection of targets for such a purpose is shown on Chart 2."

The Committee's report was approved by General Arnold and was taken to Headquarters of the Northwest African Air Force by Colonel Smart of the Advisory Council. On the occasion of the trip undertaken by Colonel Leach and the writer to Great Britain for the purpose of discussing the abrasives industry with authorities there, General Arnold directed that a visit be made to General Spaatz for the purpose of discussing the report on Italy with him and his staff (Tab 35).

The Italian report was discussed with General Spaatz and with Generals Curtis, Norstadt and Partridge and Colonel McDonald at General Spaatz' headquarters on August 1, 1943. It appeared that the Intelligence Section of the Northwest African Air Force had found the reports extremely useful and General Spaatz expressed a desire that he be furnished with information as to all strategic targets selected by the Committee within range of African bases.

#### XIV. THE REPORT ON THE FAR EAST

The Committee's directive for a study of strategic targets in Japan was dated 23 March 1943 (Tab 23). The Japanese economy had been studied more extensively in this country than in Great Britain. Considerable progress with respect to the collection of basic data had been accomplished by the Board of Economic Warfare and also by the Military Intelligence Division of the War Department. Largely based on this information, target folders covering the area had been prepared by Air Intelligence.

Under date of 24 February 1943, Air Intelligence had been directed by the Assistant Chief of Air Staff, Operational Plans, to prepare an overall target study of Japan, Chosen and Japanese occupied Manchukuo. Such a study was submitted under date of 20 March 1943. In this study, Japanese industrial targets were classified by order of priority as follows:

1. Aircraft
2. Non-ferrous metals
3. Naval bases and shipyards
4. Iron and steel
5. Petroleum
6. Chemicals
7. Automobiles and motors
8. Rubber

and some 57 key targets were selected.

At a meeting in General Gates' office, at which Dr. Mason, Mr. Hamilton, Colonel Leach and the writer were present and in which the general nature of the Committee's future operations was considered, the point was made by General Sorensen that the study referred to constituted an adequate reply to the Committee's directive. The matter was thoroughly discussed and it was decided that the Committee should proceed to conduct its own investigation along lines theretofore developed and should arrive at an independent conclusion.

It was apparent that any study of the character contemplated would not be complete or authoritative without the resources and cooperation of

the Navy. The method of approach, however, presented various complications. Through the cooperation of Colonel Edgar Lewis of the Office of the Undersecretary of War, the writer was introduced to Mr. Charles Detmar, Executive Assistant to Mr. Forrestal, the Undersecretary of Navy. The general nature of the Committee's work was explained to Mr. Detmar and to Captain Gingrich of the Navy, Mr. Forrestal's naval executive. Both expressed approval of the proposal. Captain Gingrich and the writer then called upon Captain Pickhardt of the Office of Naval Intelligence.

Although Captain Pickhardt was not himself in charge of Far Eastern matters, he arranged for a meeting with various officers attached to that division.

At this meeting, it was pointed out that two subcommittees of the Joint Intelligence Committee had been set up - one to deal with Japanese shipping and the other to deal with the Japanese aircraft industry - and that these subcommittees already included membership from the Navy and from Air Intelligence. In order to avoid duplication of effort, it was decided that the personnel of these committees should be utilized and that their work, so far as it covered the ground <sup>with</sup> the full Committee desired to cover, should be utilized.

Under date of 10 June 1943, General Gates addressed a memorandum (tab 36) to the Director of Naval Intelligence, outlining the situation and, under date of 24 June, the Director of Naval Intelligence replied (tab 37) indicating that cooperation would be given and naming naval representatives to the petroleum, shipping and aircraft subcommittees.

Subsequent to Admiral Train's letter of 24 June, it became increasingly evident that it was most desirable to have the Navy nominate personnel to serve on the main Committee. No steps had been taken by O.N.I. to this effect. The writer discussed the problem with General Fairchild who suggested that the matter be taken up with Vice-Admiral Russell Wilson's aide. The latter indicated that the problem should be outlined to Captain T. P. Jeter, Chief of the Air Branch, Operational Division, COMINCH, and

that Captain Jeter and Captain H. B. Smith-Hutton would be desirable members for the Committee.

A conference was held with Captain Jeter in which Captain Smith-Hutton participated. After the purpose and plans of the Committee had been fully explained, these officers indicated that they believed the members of the Committee should be O.N.I. personnel. Thereupon, the writer called on Captain Zacharias, Deputy Director of the Office of Naval Intelligence, who was absent from Washington at the time of Admiral Train's letter agreeing to Naval participation in the Committee's work. Captain Zacharias indicated that, in his opinion, the work of the Committee should properly be done by the Joint Intelligence Committee and that, feeling as he did, he was not disposed to suggest the names of any naval officers for membership on the Committee.

This was the state of affairs on 3 July when the writer and Colonel Leach left for England. Before their departure, Mr. Root had been advised of the status of the problem of naval representation. Mr. Root was deeply concerned at the possibility of the Navy not being represented on the Committee and a conference was arranged between General Gates, Mr. Root and General Kuter, Assistant Chief of Air Staff, Plans. As a result of this conference, General Kuter personally contacted Rear Admiral C. M. Cook, Jr., Deputy Chief of Staff, COMINCH, and a member of the Joint Staff Planners, on which Committee General Kuter also sat. On 26 July, Admiral Cook, in a memorandum to General Kuter (Tab 38) stated "the opportunity of participation in the study of strategic bombing objectives in Japan, which is being initiated by your analysts is appreciated" and appointed Lieutenant A. K. Murray as liaison officer to the Committee of Operations Analysts. As a result of the efforts of Lieutenant Murray, personnel of the Navy were appointed on subcommittees for aircraft, shipping, shipbuilding, and petroleum and, subsequently, Captain H. C. Wick, Commander USN<sup>USNR</sup>, Francis Bitter and Lt. Commander A. E. Hindmarsh, Commander USNR<sup>USNR</sup>, became members of the main Committee.

Captain Wick was attached to the office of the Deputy Chief of Naval Operations, Air. Commander Bitter was in the Air Technical Analysis Division of that office. Previous to entering naval service, he had been a professor at the Massachusetts Institute of Technology. Commander Hindmarsh was the ONI representative. Prior to entering naval service, he had served as a professor of history at Harvard College.

When the writer arrived in London in July 1943, the Ministry of Economic Warfare had concluded that it would prefer to cooperate in the Committee's study on the Far East rather than to attempt a separate study on its own. Colonel G. C. Vickers, VC, of the Ministry, who had been decidedly skeptical at the time of the February 1943 visit, stated that (a) he hoped that arrangements could be made for such participation, (b) if such participation were agreed upon, he would make available all the resources and personnel of his Far Eastern Section, (c) this would include their presence in Washington for such periods as might be necessary, (d) the Ministry would undertake to obtain the services of leading British experts and would send them to Washington at its own expense. He desired the study to be a combined operation and suggested that the basic industry studies might eventually be collected into a "Bombers' Baedeker". It was explained to Colonel Vickers that the final Committee report, for reasons of security, probably would not be made available to the Ministry; no objection was voiced to this procedure.

Numerous conferences were held in London with various other members of the Ministry, with RAF Far Eastern representatives, and with British industrialists alleged to have special knowledge of specific situations. It was agreed that, upon the writer's return to Washington, immediate steps would be taken to secure General Arnold's approval of the addition of British representatives to the subcommittees. This approval was obtained.

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The work of the several subcommittees had been proceeding to varying degrees of completion during the period from April to August; upon the writer's return, pressure was applied to effect the preparation of interim reports by 15 September 1943.

At a meeting of the various subcommittee chairmen held on 22 May 1943, the writer had prepared a summary of the method of approach to be followed (Tab 38). Each industry was to be analyzed to determine the following crucial considerations:

- a. The indispensability of the product to the enemy war economy.
- b. The enemy position as to current production, capacity for production and stocks on hand.
- c. The enemy requirements for the product for various degrees of activity.
- d. The possibilities of substitution for the product or of its decreased use without affecting front-line strength.
- e. The number, distribution, and vulnerability of vital installations.
- f. The recuperative possibilities of the industry.
- g. The time lag between the destruction of installations and the desired effect upon front-line strength.

It was further pointed out that it was of prime importance that all areas of non-information be clearly and candidly set forth and that all dissenting views be presented to the full Committee. The establishment of the above principles assured the preparation of uniform reports and facilitated the problem of overall evaluation.

The subcommittees were originally set up on the same industry basis as in the case of the Western Axis. It was felt, however, that, in addition, steps should be taken to consider the problem from the point of view of area attack and the preparation of an area study had been under discussion as early as May 1943. Prior to the writer's departure for England in July 1943, Mr. Horatio Bond of the Office of Civilian Defense called at his office. Mr. Bond stated that he was anxious to institute studies with respect to incendiary attack on Western Axis and Far Eastern targets, that he had endeavored, without

success, to contact the proper WarDepartment authorities and that he would be grateful for assistance as to how to proceed. The writer explained to Mr. Bond that, under the existing organization of the Army Air Forces, the proper office to contact would be that of the Office of Assistant Chief of Air Staff, Intelligence. It was also pointed out in general terms to Mr. Bond that a study was being undertaken by the Committee in which the subject of incendiary area attack was an important consideration. During the writer's absence in Europe, Mr. Bond approached the Office of the Assistant Chief of Air Staff, Intelligence with his proposal and obtained its acceptance. Mr. Ewell of the National Defense Research Committee was assigned, through Mr. Bond's efforts, to the task of cooperating in the study.

Prior to formal meetings to review the subcommittee reports and while the writer and Colonel Leach were in England, Mr. Root and Major Righheimer held conferences with the various committee chairmen, with a view to ascertaining their progress to date. On 29 July, conferences were held in Mr. Hewlett's office, O.E.W., with the chairmen of the subcommittees on shipping, iron and steel, transportation, petroleum and coke and coal. These conferences were also attended by Colonel Moas and Major Haas. Similar

meetings were held on August 10 and 11 at O.S.S. with the chairmen of the subcommittees on electric power, electrical equipment and machine tools and subsequently at Gravelly Point with the chairmen of the subcommittees on food, chemicals, shipbuilding and textiles. Separate conferences had been held with the chairmen of the subcommittees on aircraft, arms and munitions, non-ferrous metals, motor vehicles and rubber. From these preliminary conferences, it was evident that certain studies had progressed much further than others. Shipping, iron and steel, petroleum, coke and coal, electric power, electrical equipment and food were well under way. Substantial progress had been made in chemicals and non-ferrous metals. The subject of machine tools was well covered, but the associated studies in ball bearings and grinding wheels had not progressed.

The rubber study had not yet been undertaken by a subcommittee, as a satisfactory chairman had not been obtained. Subsequently, under Dr. Oliver Burke of the Rubber Reserve Corporation, this study proceeded quickly and satisfactorily.

No committee work had been done on transportation, shipbuilding, arms and munitions or aircraft, although individual members of those subcommittees had done work in these fields. The studies on textiles and motor vehicles had not been initiated.

Shipbuilding was handicapped by the need and desire for active Navy participation - preferably by an officer who could serve as chairman.

The aircraft subcommittee had not functioned at all. It had been contemplated, in order to minimize duplication of effort, that an existing J.I.C. committee on aircraft should constitute the CCA subcommittee on aircraft. Because of lack of progress along desired lines, it was found necessary to revamp this subcommittee.

The first meeting of the full Committee for the purpose of receiving progress reports was held on 14 September 1943. The report of the subcommittee on iron and steel was first considered. This subcommittee was particularly fortunate in having as members Messrs. Buente and Voigt of the United

Engineering and Foundry Company, who had visited practically every steel mill in Japan. The chairman stated that the available evidence on this industry was satisfactory. It was estimated that Japan had a pig iron capacity of 10,600,000 metric tons, a steel ingot capacity of 13,000,000 metric tons and a rolled products capacity of 9,500,000 metric tons. This gave her a ratio of one to seven as compared with the United States. The estimates were considerably higher than any previously arrived at.

The matter of necessary raw materials, more particularly the types of iron ore available, was discussed at length. The ores of Japan proper averaged 40 per cent iron content but low-grade ores with high phosphorous content suitable for the Bessemer process also were available locally. Bessemer steel, however, was not suitable for general armament purposes because of its brittleness. The iron sands of northern Japan contained about 40 per cent ore but were difficult to smelt because of the presence of titanium. Titanium did not hurt the quality of steel but did reduce its ductility, thus making it difficult to roll or forge. The iron ore bodies of Manchuria were large but, in general, of poor quality. However, the Japanese had developed a process for beneficiating low-grade ores so as to increase the iron content from 33 to 60 per cent in the concentrate. There were deposits of high-grade ore near Fenqihua and in the border region between Korea and Manchuria; the latter, however, had not been much developed. The ore bodies of northern Korea were large, with ore running at about 55 per cent. This ore was low in silica which gave it a value out of proportion to the quantity produced. The figures for production in China were difficult to arrive at, although certain of the producing districts had been large producers in pre-war times. Iron ore from the Philippines and Malaya was of particular importance to the Japanese steel industry because it could be blended with poor ores to improve results.

Scrap was essential to the production of steel, whether in blast or electric furnaces or in the Bessemer process. In pre-war times, the Japanese steel economy had been based on the use of scrap, because it was the simplest method of making steel and called for the least equipment. An adequate

supply of scrap depended upon an advanced industrial economy which Japan lacked and, therefore, in the middle 1930's, an attempt was made to place the industry on a war footing by utilizing pig iron in a ratio of 70 per cent of the blast furnace charges to 30 per cent scrap. It was not believed that this ratio had been achieved. In the United States, for example, a ratio of 55 to 60 per cent was the best ever attained and the technical problems were great. It was believed that the maximum ratio with which to credit the Japanese would be 65-35 per cent. This was with respect to electric furnace and open hearth production. The Bessemer process required only 10 per cent scrap. The greater portion of scrap was derived from circulating supplies within the steel mills (60 per cent); about 20 per cent from machining and fabricating operations and 20 per cent from junking operations and battle recovery. Immediately available supplies of scrap were nominal but it could not be said that the situation with respect to scrap was critical.

It did not appear that there was any shortage of alloy materials, except perhaps with respect to nickel whose use was essential in the making of stainless steel. Setting aside the question of nickel stocks on hand, the greater portion of production had to be shipped into Japan.

Japan was particularly well situated with respect to electric furnace capacity for the production of high quality alloy steels. This capacity amounted to 12 per cent of total steel making capacity, a far greater relative proportion than in the United States or Europe.

It was not believed that there were any sizeable stocks of iron ore or ingots on hand.

Steel production was concentrated in seven principal districts. The most important was at Yawata, in northern Kyushu, where five plants accounted for 23 per cent of the production of pig iron, 26 per cent of steel ingots

and 22 per cent of rolled products. The Tokyo-Yokohama district accounted for 12 per cent of pig iron, 18 per cent of steel ingots and 15 per cent of rolled products. The Anshan district of Manchuria accounted for 15 per cent of pig iron, 8 per cent of steel ingots and 7 per cent of rolled products. The Hirohata Works, near Himeji produced 6 per cent of pig iron, 6 per cent of steel ingots and 6 per cent of rolled products. The Kamaishi district produced 4 per cent of pig iron, 5 per cent of steel ingots and 5 per cent of rolled products. The Nagoya district was particularly important for alloy steels. It produced 3 per cent of steel ingots and 4 per cent of rolled products. Other concentrations occurred in Tokuyama, Mororan-Wanishi and Kenjiho, in Korea.

Transportation was an important element in the steel picture because of the many ton miles of raw materials per ton of finished product. Shipping requirements for ore, coal and coke and, to a lesser extent, nickel were weak points in the steel picture.

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The shipping subcommittee report was presented by the chairman, Mr. Paschal. Naval representation on this subcommittee consisted of Lieutenant (jg) Henry D. Owen, USNR. Although Japan entered the war with a merchant fleet of sizeable proportions as compared with her then economy, it nevertheless appeared that it was insufficient to meet present needs. The Japanese had stated that a merchant marine of 15,000,000 tons was required to fully exploit all the areas now occupied; it was the chairman's view that this figure was optimistically low. As of 1 August 1943, steel ships of over 1,000 tons totaled 4,385,000 gross tons, including 355,000 tons of tankers. In addition, there was approximately 350,000 tons of steel ship tonnage under 1,000 tons which was employed principally in the Inland Sea. The efficiency of these ships was about 2/3 that of larger steel ships. Wooden ship tonnage was estimated at 600,000 gross tons but its relative value might be depreciated by 2/3. Allowing a figure of 1/14 for ships laid up for ordinary repairs and 1/14 for ships laid up for war casualty reasons, it was estimated that Japan's total usable tanker tonnage was 300,000 gross tons and her total usable cargo tonnage 4,214,000 gross tons.

The figures as to tonnage on hand were reliable because they were based in part on gross errors in Japanese censorship which permitted publication until the middle of 1941 in official government documents of call numbers, names, gross tonnage and ownership of all merchant ships.

Construction was estimated at approximately 50,000 tons a month while losses were running about 160,000 gross tons. It was estimated that the construction rate would increase during the balance of the year. On the other hand, the number of ships salvaged would decline. Construction itself might rise as high as a rate of 1,000,000 tons a year. This figure was based in part on appropriations, in part on the size of the shipyards and in part on statements of the production planned.

Requirements for naval auxiliaries were figured at 500,000 gross tons

170,000 tons tankers) and for the military shipping pool at 625,000 tons.

The latter figure did not include the carrying of military cargoes; total military use might amount to between 800-850,000 tons. Requirements for maintaining Japan's economy were calculated at about 3,200,000 tons, including 100,000 tons of tankers. Total shipping requirements were calculated at 4,380,000 tons for cargo vessels and 420,000 tons for tankers. The figures on economic requirements were based upon preliminary reports received from other subcommittee chairmen.

As of 1 August 1943, there was an estimated shortage of 320,000 tons of tankers and 126,000 tons of cargo ships measured in terms of minimum requirements. The tanker shortage was being handled by shipping oil in drums on dry cargo vessels. There was evidence, some from official government sources, that the Japanese were shifting traffic wherever possible from coastwise steamers to rail lines.

If the rate of sinkings were continued, it was estimated that the Japanese would have to withdraw from the outer zone by the middle of 1944.

The report of the subcommittee on food was presented on 15 September by the chairman, Captain Scott of A-2. The members of the subcommittee included Messrs. Wolf Ladejinsky and Raymond Moyer of the Department of Agriculture.

It appeared that Japan had started in the early 1920's to make herself as nearly self-sufficient as possible with respect to food. This involved irrigation projects, the perfection of new seeds, scientific farming and the development of a nitrogen fixation industry. By 1937 Japan, Formosa and Korea, taken together, were 98 per cent self-sufficient. This result was achieved principally by great applications of nitrogenous fertilizers to the rice fields. 115 pounds per acre was the average used, as compared with 48 pounds in Holland and 1.7 pounds in the United States. Nitrogen fertilizers were completely soluble; organic fertilizers were not. Irrigated crops, such as rice, required soluble fertilizers. 85 per cent of all rice

in the Japanese Islands was grown under irrigated conditions and 80 per cent of all nitrogen fertilizers produced was used by the rice growers. Japan, Formosa and Manchuria, taken together, were now believed 83 per cent self-sufficient. Rice stocks in the Japanese Islands were estimated at about 30 per cent of annual consumption.

The chief food supplies available were in southeast Asia, particularly Burma. Exports from Formosa totaled 8 per cent of Japanese requirements.

Large amounts of copra were available in the Japanese controlled territories. Copra might cover about 6 per cent of Japan's requirements under emergency conditions, but ~~was~~ was not very palatable. It could also be used as a fertilizer, possibly to the extent of 15 per cent of requirements.

The nitrogen fixation industry was concentrated in 39 plants of which between 7 and 10 produced 72 per cent (preliminary figures). Their destruction would eliminate all fertilizer production because the balance of the nitrogen produced would have to be used for explosives. Crop yields would be reduced between 25 and 30 per cent. If all shipments of food from Formosa and points south were cut off thereafter, famine would ensue.

Japan produced two crops of rice per year. If attack on nitrogen plants could be made in December, the winter grain crop would be reduced from 7 to 10 per cent and the August rice crop about 25 per cent. Attempts would be made to move rice from southern Asia but this would have to await the harvests in that area which begins in July. Maximum effects would be felt in the second spring after attack, or 16 months later.

Although there was little information on the point, it was not thought that substantial stocks of nitrogen existed. The bottleneck, in reconstruction of the plants, would be the compressors which would take perhaps 18 months to manufacture. In the absence of repeat attacks, new plants could be erected by the time maximum effect was being felt. This would mean that, if the Japanese could hang on for 6 to 8 months more, the shortage might be alleviated. The use of substitutes, such as soy beans and copra, was postulated in arriving at the above figures.

The report on coke and coal was presented by the chairman of the sub-committee, Dr. Schneider of the Foreign Economic Administration. The coking industry in the Far East was very highly concentrated. Six plants accounted for 72.5 per cent of production and three for 61 per cent of production.

There were 53 batteries in the six plants and 37 in the three plants referred to; most were located adjacent to each other. It was thought that information with respect to coke was complete. It would take approximately two years to build new plants. It was possible that there might be some new construction near Seishin and in Hokkaido but it was not felt this would change overall figures by more than 5 per cent.

All coke plants were believed to be producing at 95 per cent of capacity. The raw material, coking coal, was obtained by Manchurian plants partly from their own sources and partly from China. The large plants in Kyushu depended in large part on shipments of coking coal from China.

Japanese coke ovens were largely constructed either under the European Otto process or the American Koppers process and from imported materials. However, the Japanese were capable of building their own.

Japan and her controlled territories produced and required about 13 million tons of coke a year, of which 11 million tons was "furnace grade". This type was hard, would withstand pressure and was sufficiently porous to be used in blast furnaces, in water gas production, in hydrogenation of coal and in metallurgy.

Requirements for furnace grade coke totaled 9 million tons per year, indicating a cushion of about 18 per cent. Demolition of the six recommended plants, however, would reduce production to 3 million tons.

Stock piles of coking coal were small as such coal ~~did~~ not weather well. It is not customary in any country to stock coke.

The chairman estimated that it would take about two years to get the six plants back into operation. However, bee hive ovens could be constructed to produce furnace grade coke. Some might be completed within a period of two months and small production might be achieved. To make up for the destruction of the six plants would require the erection of 13,000 bee hive ovens; these would take a minimum of 20 months to build. There was considerable discussion as to the time needed to build a Koppers type battery. Major Lowe stated that Mr. MacArthur of the Koppers Company had testified, in connection with the Western Axis study, that the average time required was 9 months and that it might be accomplished in six. The chairman replied that that might be true of a battery as few as 25 ovens, though he did not know of such a record ever having been achieved. The nearest to it was the Kaiser Company plant in California which was completed in about 6 months. He believed that any large number of ovens would take at least 18 months to construct.

It was said that any direct bomb hit on any part of a battery would fuse the bricks throughout the battery and cause complete destruction.

The by-products of coke were of importance throughout industry and benzene, toluene, phenol and cresol were of particular importance to the military effort. Destruction of the six plants would reduce benzene and phenol 59 per cent and toluene 55 per cent. However, the damage might be mitigated by various expedients. The position in toluene could be brought back to normal because Japan had cresol available and there was a simple method of making toluene out of cresol. Coke oven gas was important to the blast furnaces in the iron and steel industries and was a major source of hydrogen for industrial purposes. Destruction of the six plants would reduce production of hydrogen by 26 per cent. This would, in turn, reduce production of synthetic gasoline by 26 per cent and of synthetic ammonia by 31 per cent.

About 42 per cent of the coal used was produced in the Japanese Islands, about 22 per cent in Manchuria and about 20 per cent in China. Japan imported

into the Islands principally high grade coal used for coking. Coal produced in Hokkaido and Kyushu was of a grade which could not be used by itself in coke ovens, although it might be mixed in with imported coals in amounts up to 50 per cent. Occupied China was the major source of the important coking coal. Manchuria was a secondary source (Manchuria produced about 90 per cent of its own industrial requirements).

On 16 September, the Committee met for the purpose of receiving the report of the shipbuilding subcommittee. The Chairman, Dr. Brown of A-2, reported that information as to the location of the major shipyards was accurate, that the amount of new ways constructed therein could be reasonably well determined, and that it was unreasonable to suppose that new shipyards could have been erected without our knowledge. Despite these facts, the problem of estimating present and prospective shipbuilding output was very difficult. It was known that the need for rapidly increased production was obvious but it was not thought that Japan had been able to achieve any increase anywhere nearly comparable to that achieved by this country. During the last war there had been considerable shipbuilding undertaken in Japan; during the 1920's, Japan's merchant marine was supplemented by the purchase of second-hand ships. Since Pearl Harbor, confiscation of United Nations' ships throughout the East had added to Japan's merchant marine. Japanese yards, unlike the American yards, were old and did not have the room or layout requisite to convert from riveting to welding. Without a changeover to welding, there was reason to believe that the extraordinary percentage increase achieved by American industry could not be duplicated. Welding permitted pre-assembly in which parts of ships were laid out in different spots. This in turn required special cranes for handling; the Japanese yards were not designed to permit this. A great volume of Japanese statements indicated dissatisfaction with ship construction. The reasons given varied, shortage of steel and labor being prominent. The subcommittee did not believe that shortage of electric power as alleged by some was a prominent factor. The point had been raised that 1-hour a day operation might have been impeded by the necessity for maintaining blackouts. Whether this had been the usual practice in view of the war situation and the fact that only one air raid had been made in Japan was doubted. Such

evidence as there was as to night operations was not conclusive. The subcommittee figures for 1943 shipbuilding included some night operation and for 1944 continuous night operation. If work at night were not undertaken it was not believed that more than 500,000 tons of merchant ships could be constructed. In 1937 when 425,000 tons of shipping were turned out, the yards were operating on a 24-hour basis. Since that time, it was believed that 29 new ways had been constructed capable of an additional 160,000 tons of capacity. This was based upon a standardization of vessels to an average size of 4,000 gross tons and the construction of 2 such ships per way per year. In the year 1919, 600,000 tons were launched; the ships were then built in Japan in from one to two months. It was argued, however, that Japan was able at that time to get steel from the United States and that labor was not a problem. On the other hand, there could have been difficulty in training labor to meet the great increase in ship production from 1917 to 1919. The question was raised as to the time necessary to build new ways and as to their possible location. In the United States, a shipway could be erected in about two months and ships launched eight months after breaking ground. It was pointed out that there was steel and surplus power in Manchuria but the chairman did not believe there were adequate plate facilities there. The chairman did not feel that Japanese statistics on shipyard employment were a good basis because certain of the yards combined engine and boiler building and ship repair with hull construction. It was estimated that there were 110-120 ways in private yards in Japan capable of building ships over 1000 tons and 20-25 in naval shipyards. However, even in peace time, a large percentage of naval vessels were constructed in private yards, the naval yards being used mainly for fitting out and repair. The chairman had taken a period of six months for the construction of the average size ship for the year 1943; he believed that a somewhat lower figure for 1944 might be achieved. The Oriental Economist, in 1940, stated that, on the basis of 98 ways and of existing techniques, a production of 800,000 tons a year could be easily achieved; this probably

assumed no naval construction and no diversion of labor to excessive repairs.

Using a figure of 4,000 tons as an average, this worked out to two ships per yard per year. Such information as was available indicated that naval construction was not being given any priority over merchant construction. It was pointed out that it would be possible to construct ships in a certain percentage of Japanese dry-docks. This would depend upon whether repair capacity, however, was larger than bases. It was estimated that perhaps 200,000 tons could be so constructed. The possibility of a limitation on construction due to difficulty with engines, boilers and heavy forgings was also raised. It appeared that the <sup>L</sup>loyds surveyors now available in the United States had estimated 1944 construction at 500,000 tons. British opinion, however, had been consistently conservative on this point. There was some evidence that the British believed 800,000 tons for 1944 was possible, including naval construction in private yards.

Wooden ship construction was being pressed. It was felt that approximately 100,000 tons of this type could be completed in 1943 and perhaps 800,000 tons in 1944. However, the effectiveness of this tonnage would be only 1/3 of that of steel ships. The subcommittee had, up to the moment, used a figure of 1/2 as conservative. There were about 600 yards capable of constructing wooden ships in Japan proper. About two months would be required to complete a 200 ton ship.

Ship repair facilities were widely scattered. About 30 per cent were at Hongkong and Shanghai. Dry docks were not particularly vulnerable although they would take a long time to build. Perhaps the most vulnerable aspect of shipyards would be the engine plants. These appeared to be concentrated, 65 per cent in 5 yards, and required specialized machine tools. It would take approximately six months to rebuild them.

The Committee met on 17 September for the purpose of receiving the report of the subcommittee on oil, presented by Mr. Hewlett of FEA. Subcommittee members, other than Mr. Hewlett, consisted of members of the Far Eastern Subcommittee of the Enemy Oil Committee. The chairman stated that, other than for fuel and diesel oil, Japan's petroleum position appeared satisfactory.

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Japan depended heavily on the East Indies for petroleum supplies. The navy was the largest consumer, accounting for 3/4 of estimated requirements for fuel oil of 45 million barrels and the merchant marine accounted for 1/6 of such requirements. Naval requirements were based on estimated activity of the various categories of ships of the Japanese navy at average cruising speeds; the degree of activity of the navy would naturally have a most important bearing on the whole problem. The relatively low merchant marine requirement was due to the fact that only 40 per cent thereof was oil burning. The use of oil for industrial or private consumption in Japan was at a minimum.

It was believed that the stock position in all types of petroleum products, other than fuel oils, was relatively satisfactory and might range from 1½ to 2 years' requirements. The figure varied between classes of products; in aviation gasoline it was two years; fuel oil stocks, on the other hand, did not exceed six months' requirements and, subtracting non-operable stocks, only four months' requirements. The figures on stocks were worked up from a known base in 1929; annual imports and production were added and consumption deducted. The final figure arrived at was 50 per cent higher than any previously used either in Washington or London. Obviously, such a method of calculating stocks would result in a strong possibility of error.

Seventy-five per cent of Japan's fuel oil supply was derived from the East Indies and the balance from (a) indigenous crude and (b) synthetic production. Because of the tight tanker position, it was not believed that Japan could move substantial quantities of fuel oil to the Inner Zone in order to build up stocks there. There was some indication, however, that tankers were being supplemented by dry cargo ships. Upon the basis of a 4-day turn around time for tankers, it was figured that a minimum of 37 tankers of approximately 288,000 gross tons would be required; this compared with an estimated operable fleet of approximately 280,000 tons. The turn-around time was a critical factor in determining tanker requirements. At Palembang, for example, from which a large portion of Netherlands East Indies oil was derived, there was only one tide a day and only a 3/4-loaded tanker could be maneuvered in the river.

It was believed that the main shipments of East Indies oil were to Japan, to Truk and to bases in the southwest Pacific and Indo-China. Supplies at Truk might total six months' requirements. If Truk were abandoned and the Japanese navy were based in the Netherlands East Indies, the oil position would be greatly relieved. Pulling the navy back to Japan would not achieve this purpose because of the demand for constant sea patrols and the long supply routes. On the other hand, naval bases in the Netherlands East Indies were not an ideal strategic position from which to defend Japan.

Synthetic capacity was estimated at about 10 million barrels and synthetic production at between six and seven million barrels. There were several synthetic plants in Manchuria - some thought 14, but the British view was that there were only 7. Intelligence as to construction of new plants was lacking. Any such construction would have been in Manchuria, Korea or Hokkaido. From Socony Vacuum sources, it had been learned that the Japanese intended to build about 30 synthetic plants. If full production were credited to 15 possible Fischer Tropsch plants in Japan and Manchukuo, domestic production could be increased by 30 per cent.

There was a potential of 75 million barrels in the Netherlands East Indies, a large percentage (30%) of which required no refining or a very limited refining process. Out of this, however, only 36 million barrels of fuel oil could be obtained. There was considerable discussion as to what the limiting factor was: (a) getting oil out of the ground, (b) tankers, or (c) refining capacity.

The chairman's view was that it was primarily in getting oil out of the ground, although the limiting factor at Pladjoe was the refinery and at Balikpapan, transportation. If more crude oil production were achieved in 1944 as the damage done to the oil fields by the Dutch was repaired, some further increase in refining capacity would be desirable. The only refinery that presently appeared undamaged and worthy of attack was Pladjoe whose destruction could roughly be termed the equivalent of the loss of 9 tankers. Pladjoe also had capacity to produce 2/3 of Japan's aviation gasoline requirements.

It was apparent that the difficulty with the petroleum picture lay in estimating (a) requirements and stockpiles, (b) the degree of activity at NEI plants, (c) the location and capacity of synthetic plants. From a strategic point of view, fuel oil was the point to stress and tankers and Pladjoe were the chief targets.

The report of the subcommittee on electrical equipment was presented by the Chairman, Mr. Dorr of O. S. S. There were five classes of productive facilities entitled to primary strategic rating: (a) electronic tubes, (b) precision electrical measuring instruments, (c) insulating wire and cable, (d) fractional horsepower motors, magnetos and small generators, (e) spark plugs. Classes (d) and (e) appeared to be either too dispersed or too easily replaceable to warrant attack. Heavy generating equipment and medium generators could be excluded because of the long time lag between attack and effect on front-line strength.

Tubes, the heart of the electronic industry, were of many kinds. There was no excess capacity and supplies were believed tight in the light of war-time needs. Tubes were expendable in themselves and the sets in which they were used for military purposes were expendable in combat. Although the electric light bulb industry was decentralized to small shops, tubes for military use could only be produced in factories having proper labor supervision and the necessary testing apparatus. The vacuum pumps used to exhaust ordinary light bulbs were not adaptable to the manufacture of electronic tubes.

The chief bottleneck in the radar industry was the production of metal components, that is, the making and drawing of wire filaments. Two plants in Tokyo were thought to account for 90 per cent of wire production but there was some disagreement as to whether there was not a third plant of importance. The wire drawing machinery, although relatively small, was delicate. There was nothing to identify a building in which this machinery was housed. However, the floor plans of Tokyo Electric Co. indicated where it had been in that important plant in 1940-1941. It would take at least six months to replace wire drawing equipment. The same was

probably true of high-grade vacuum pumps. Specifications in this country called for four spares per annum for each radio tube. This figure might prove a high requirement, especially for Japan. Radar tubes had to be replaced at an even faster rate.

Precision electrical measuring instruments were important to aircraft, ships and industry. Their expendability was high and it was felt that the Japanese would have difficulty in meeting war-time demands for them. The industry, in Japan, had developed rapidly in the last ten years. Of 21 known plants, three appeared to account for at least one-half of the finished instruments and components. The tools and testing equipment used were susceptible to shock. Successful aerial attack might destroy some three months' production of finished instruments awaiting shipment to consumers.

It was felt that a 25 per cent reduction in the reduction of insulated wire and cable would have to be achieved before military capabilities would be seriously interfered with. About 64 per cent of production was concentrated in four plants whose insulating machinery would be easy to damage and difficult to replace. There were hundreds of these machines in cable plants and they were highly vulnerable to fire.

In the United States, 70 per cent of the fractional horsepower motors and small generators found their way into military equipment. It was believed that this would probably also be true in the case of Japan. As little specialized equipment was necessary, plant recuperability was high. Nine or ten plants manufactured magnetos but at least 25 other plants could be turned over to their production if necessary.

Spark plugs, although important, were not a good target. Five or six plants accounted for present production but the metallic components could be made in any machine shop and household porcelain manufacturers could provide the necessary insulators.

Although some medium generating equipment was used in ships, the great bulk of this equipment found its way into industrial use. Attacks upon

the industry, therefore, would have delayed though pervasive effects throughout the economy. There was some evidence that there were only four producers of this type of heavy equipment but the plants were of heavy construction and did not appear vulnerable to fire.

The report of the subcommittee on electric power was presented on 18 September by Mr. Fahs of O. S. S., Chairman. Electric power, particularly in the Japanese Islands, had to be considered with a view to the several power supply areas therein. The Japanese electric power system had developed along both English and German lines. This resulted in some areas operating at 50 k.c. and others at 60 k.c.; interchange of power between such areas was difficult. The electric power system was designed to serve specific industrial areas, such as the Osaka-Nagoya area, the Tokyo area, the North Kyushu area, and Korea area and the Manchuria area.

The basic sources of power were the hydro-electric plants. Such plants in Japan, as in the case of Italy, were based on steep water courses and narrow valleys necessitating a series of small dams rather than one or more large dams as in the case of the principal German developments. The number of hydro plants, their location and their construction led to the conclusion that they were not a good target system.

Japan had definite wet and dry seasons. During the dry season, from November to February, the demands for electric power exceeded the amount which could be supplied by the hydro system alone and, at this season, an important part of the total load fell upon thermal stations. Thermal stations, particularly their boilers, were more vulnerable than hydro plants. The relative importance of thermal stations varied with each supply area. In order to obtain the maximum results, it would be necessary to attack the thermal stations during the dry season.

In the event of a shortage of power, it was thought that the large users of current - iron and steel, aluminum, nitrogen fixation, calcium, carbide, coal mining and ordnance - would be forced to reduce their output.

The first group to be affected would probably be the nitrogen plants. Shipbuilding and aircraft were relatively small consumers of electricity. The time lag of the effect on front-line strength of attack on heavy industries of this nature could be at least six months and probably a year. Attack on power plants was a blow against the general industrial set up and might weaken Japan more in the long run than any other means of attack.

The three largest steam plants in the Empire were located in Amagasaki in the very important Kobe-Osaka area. Two of them were only 400 yards apart. The Osaka-Nagoya area was the largest producer of aircraft as well as a large producer of steel, aluminum and ordnance. The possibilities of obtaining emergency supplies in this area during the dry season were very limited - perhaps 150,000 k.w. Although this amount of power would suffice for the aviation industry, the high priority aluminum industry in the area would suffer.

In the Tokyo area, a larger proportion of power was supplied by the hydro-electric plants. Four big steam plants in or near Tokyo and two hydro plants accounted for about 35 per cent of the power supplied to Tokyo during the dry season. Perhaps 5 per cent of Tokyo's power requirements could be obtained from emergency sources. Tokyo was second in importance as a producer of aircraft and ordnance and stood high as a producer of aluminum, nitrogen, chemicals, zinc and steel.

In northern Kyushu, thermal stations had an even more important role. Eleven stations (3 in the Yawata Steel Works) accounted for in excess of two-thirds of requirements in the dry season and one-half in the wet season. North Kyushu was particularly important as a producer of steel, heavy chemicals and coal.

There was evidence of considerable new power construction in Korea, particularly in the Yalu River district. This development was based upon one large storage dam. The main power plant was built into the

base of this dam making it a very difficult target. It was suggested, therefore, that the transmission network in this area might be the best subject for attack.

The bulk of Manchurian power supply was derived from thermal stations located near coal supplies and from the Yalu River and the Sungari hydro-electric stations.

It was believed that Japan was building and had the capacity to build new electric power plants at the rate of about one million kilowatts a year. The greater portion of such capacity was for hydro plants.

The report of the subcommittee on rubber was presented by the Chairman, Mr. Burke of the Rubber Reserve Corporation. It appeared that, as a result of the capture of Malaya and the East Indies, Japan had unlimited supplies of crude rubber. It was felt that there was at least a year's stockpile both of crude rubber and of rubber processing chemicals in Japan proper. It was doubted, however, that there was any substantial stockpile of finished rubber goods, particularly tires. Three plants accounted for 32 per cent of tire production. However, in the event of their destruction, it was thought that other rubber processing firms could be converted to tire manufacture within a period of six months. Because of its convenient location, it was suggested that the destruction of the Java tire manufacturing plant of the Goodyear Tire and Rubber Company might cause the Japanese army considerable inconvenience.

The report of the subcommittee on non-ferrous metals was presented by Lt. Colonel Rice, A. C., on 28 September 1943. This report was in the nature of a preliminary statement only. The indications were that Japanese Inner Zone production of copper, aluminum, lead and zinc failed to match war-time requirements. Inner Zone production of these metals was approximately 70 per cent, 40 per cent, 55 per cent and 70 per cent, respectively of requirements. As a result of the capture of Bintan and the Netherlands East Indies Japan had obtained access to all the bauxite she needed. As of September 1943 stocks of aluminum and copper equal to approximately one years requirements. Stocks of lead were equal to approximately 1 3/4 years requirements and stocks of zinc were equal

to approximately nine months requirements. The figures on stocks were arrived at by going back to known production in 1938, adding imports of metals and concentrates and deducting normal consumption at the average of the rate for the period 1932-1938. It was assumed that one-half of imports had been used to develop new industrial facilities and that one-half had gone into stocks. Captured stocks had increased the potential stock-piles but there was no indication that such stocks had been transported back to Japan.

As result of the capture of the Bawdwin mine in Burma, Japan had attained <sup>etc</sup> success to all the lead and zinc she would require. The mine, however, had been damaged and there was some doubt as to how much of these minerals had actually been transported back to Japan.

In the case of aluminum, over 60 per cent of bauxite was imported from Bintan and the Netherlands East Indies.

It was not thought that there were any worthwhile targets in the tin or copper industries. The best targets in the copper industry would be the concentrating plants at the mines. It was believed that there was an excess of smelting and refining capacity over ore available. There was overcapacity in the magnesium industry and little evidence of any great use of magnesium in aircraft.

It was the chairman's view that many widely circulated estimates of non-ferrous metals production in Manchuria were exaggerated. With respect to aluminum production in that country from shales and clays, the chairman reported that Dr. Blough of Aluminum, Ltd., did not feel that such production could total the 40,000 ton figure the chairman had used. Dr. Blough based his opinion on the technical difficulties involved in the shale process. The main aluminum plants in Japan were at Shizuoka and at Shimonoseki.

Considerable discussion followed as to whether or not any lead and zinc had been obtained from the Bawdwin mines. It was pointed out that it seemed strange if (a) Japan was short of lead and zinc, (b) there were great supplies in Burma, (c) it was well known that a Burma campaign was to be

undertaken, great efforts would not be made to get the supplies out immediately. It was also pointed out with respect to copper that it seemed strange that if the copper situation were easy, Japanese troops should be using steel shells with a very thin brass coating as appeared from specimens captured at Attu.

The report of the subcommittee on railway transportation was presented by Mr. Paschal of FEA. It appeared that the railway system of the Japanese Islands was based upon a uniform gauge of  $3\frac{1}{2}$  feet, but that the standard gauge of China and Korea was based on the  $4\frac{1}{2}$  feet gauge used in the U. S. In the southern areas, the usual gauge was 3 feet. It was difficult, therefore, for Japan to establish the oft-discussed Tokyo-Singapore railroad lines. There were no railroad lines of great economic importance in Indo-China. The Burma-Thailand line did not appear to have been completed and when completed would be used principally for the transportation of troops. The southern area as a whole was limited in its possibilities because of the narrow gauge and small locomotive stocks. From the Indo-China border north, there was a road bed which was still in fairly good condition but there was a gap of some 200 miles between it and the Chinese railway lines. The area in between was not controlled by the Japanese at this time.

Japan's main railway effort was devoted to moving increasing quantities of heavy commodities within Japan and in the Manchuria-Korea area with a view to reduction of shipping requirements. The key railroad movements on the mainland were north of the Yangtse area and involved coal traffic from Shantung and from the mines of the Pekin-Tientsin area. Other heavy commodities carried out of China included salt; this now moved to Korea for shipment. The greater portion of the coal referred to went to the Showa steel works at Anshan. All traffic between the great coal producing areas and the Showa Steel Works passed over a 20-mile stretch of double track line near Mukden which, unfortunately, had no highly vulnerable point. Successful attack on this stretch would also interrupt traffic between north China and Japan.

There was evidence that many of the lines in Manchuria and China had been double-tracked and that double bridges had been built at vulnerable points in Manchuria and Korea. It was the chairman's belief that, in order to save on shipping, ports on the China Sea and on the Korean coast were being greatly developed. Destruction of the Luan River Bridge would stop the movement of all commodities to Manchuria and also movements of coal to Chinwangtao for shipment to Japan.

Manchurian railway traffic had a density twice that of China and about half that of the Japanese Islands. The northern Manchuria routes carried agricultural products, timber and coal to the north Korean ports of Seishin and Kashin. The bottlenecks on the northern route were the bridges over the Tumen River. Fusan in Korea was increasing in importance and might eventually prove as great a port as Dairen.

The railroads of the Japanese Islands were being used to capacity. Their most vulnerable features were bridges and the most vulnerable line was that from Shimonoseki to Osaka. The car ferry services between Honshu and Hokkaido and between Korea and Honshu were of great importance and were vulnerable to air attack.

Railroad equipment manufacturing plants in Japan were not highly concentrated. The chief shortage in equipment was in freight cars.

The report of the subcommittee on the aircraft industry was presented by the chairman, Major Bower, AC (A-2). The subcommittee had not met as such and the report therefore represented only the views of the chairman.

On the issue of requirements, it was deemed that Japan would need all the aircraft it could manufacture. It was suggested that production was about equally divided between bombers and fighters, the tendency being toward the manufacture of an increasing percentage of fighters. Total annual production was estimated by the chairman at 10,000 planes - 650 combat planes per month and 175 trainers and transports. Although production of trainers in the United States approximated 50 per cent of combat type, it was the chairman's view that the percentage in Japan was much lower - approximately 25 per cent.

Various methods of estimating production had been attempted. Estimates based on plant capacity varied widely - for example, in one plant, from 300 to 6000 planes a year. Machine tools, engineers' estimates, floor space and accumulated "bits and pieces" of intelligence had also been used as measuring sticks in determining capacity but no very accurate result had been attained. The production figure arrived at was the chairman's best guess after weighing all these factors.

The chairman stated that analysis of Japanese combat losses during the last six months led to the conclusion that production of combat type planes would have to be at the rate of 668 per month to permit replacements. He further stated that analyses of name plates in the Southwest Pacific Theatre had resulted in a production estimate of 655 combat planes a month.

Mr. Meiklejohn, FEA, a member of the subcommittee stated that, on the contrary, machine tool analyses and name plate analyses conducted by MEW and FEA indicated that production was between 12,000 and 15,000 planes a year.

Production was not limited by supplies of aluminum. Although there was not much information on ball bearings, the Japanese could presumably turn out sufficient quantities of that article. There seemed to be no known bottleneck in components which would prevent a rate of production higher than 10,000 planes a year. The Chairman's and Major Haas (A-2) felt that the overall problem of allocation of resources was the limiting factor.

Over 150 plants were known to produce planes, engines and components but only 20 were thought to be of major importance. The percentage of plane or engine production in any one of these plants was not known. It could be fairly well ascertained, however, which plants were the most important; 20 plants represented over 50 per cent of aircraft and engine production. To a certain extent (from analyses of inspection stamps) it was possible to determine what type of planes were being manufactured in the important plants. Some plants known to be in operation had not yet been physically located.

Although there had been some decentralization of the industry - for example, a definite trend from Tokyo to Nagoya - the terrain of Japan proper limited the amount of such decentralization. While it was suspected that some aircraft production would be decentralized to Manchuria, there was no definite evidence that this had been done.

It was concluded that extensive reconnaissance was necessary to establish accurately the location and productive capacities of the various plants.

The subcommittee on textiles not having met, a preliminary evaluation of the subject was given by the chairman, Major Harry J. Delaney, AC (A-2).

Forty per cent of the fibres available for clothing and military equipment were cotton and another 40 per cent rayon and staple fibre.

The textile industry was not a good target because of large excess capacity and because the plants were widely scattered it could best be attacked through shipping as the position in raw materials was tight and they had to be imported from China, Korea and the Philippines.

The report of the subcommittee on machine tools was presented by its chairman, Mr. Chandler Morse, O. S. S. The discussion covered machine tools, cutting tools and gauges, anti-friction bearings, abrasives and grinding wheels. The machine tool industry had expanded rapidly both in size and in technique in Japan in recent years. There were in excess of 400 machine tool manufacturers. Of these, some 62, operating about 100 plants, accounted for about 95 per cent of production. It was felt that the Japanese now had all the material and "know how" to manufacture the most difficult machine tools. Because machine tools were not expendable and because they lay deep in the economic process, they were not primary targets. They might become important for attack subsequent to attacks on high priority industries and in order to prevent the latter's recuperation.

Quantitatively, Japan was able to produce all the cutting tools and gauges required. It was possible that the industry was so concentrated as

to warrant some attention, but information was not definite on that point.

Anti-friction bearings were deemed a primary target system. Requirements probably exceeded production and the great bulk of production was concentrated in seven plants in the Tokyo and Osaka areas.

Information as to the grinding wheel industry was unsatisfactory. There was some indication that there might be a concentration around Hiroshima, but it could not be definitely stated that all producers were known or the type or quantity of wheels produced by known producers.

The report of the subcommittee on motor vehicles was presented by the chairman, Mr. John de Wilde (FEA). Under existing conditions of warfare in the Far East, the motor vehicle industry did not appear of primary significance although it might become so in the event of large scale ground operations. Present new truck requirements were estimated at approximately 20,000 a year and maximum requirements at 45,000. Present tank requirements were estimated at 1000 a year with maximum requirements and, in the event of large scale land fighting, at 2000. Capacity greatly exceeded requirements in both types of equipment and it was thought that much of this excess capacity was being devoted to the manufacture of other types of armament. There appeared to be large reserves of motor vehicles. It was concluded that the industry did not present an attractive target except insofar as it had been converted to production for other high priority industries.

On or about 21 September, an inquiry was received from the Assistant Chief of Air Staff, Plans as to the progress being made in the Committee's studies and it was suggested that the Committee's final report be completed by the middle of November. A conference was being scheduled between the President and the Prime Minister and their staffs for late November at which the development of Far Eastern strategy was to be considered.

At about the same date, the writer received a visit from Colonel Harman who stated that he was Chief of Staff of the XX Bomber Command under which all Very Long Range bombers (B-29's) were being placed, and that General Arnold had directed him to contact the Committee for the purpose of dis-

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cussing Japanese strategic bombardment targets. The nature of the Committee's work, as well as progress being made, was outlined to him and he, in turn, furnished information as to the range of the aircraft. This was set at 1600 miles. Upon leaving, he stated that he would consult with his Commander, Brigadier General Wolfe, as to the best means of correlating the intelligence activities of the Command with the Committee's studies.

It was his feeling that a representative of the XX Bomber Command A-2 Section should come to Washington for the purpose of working with the Committee and familiarizing himself with its procedures.

Although no final decision could be taken in the absence of Committee action, it seemed to the writer and to Mr. Root that it would be advisable to inform General Arnold of the nature of the progress being made and the probabilities of primary target selections. This progress was outlined in a progress report submitted to the chairman under date of 24 September 1943 (Tab 39). Mr. Root arranged for a conference with General Arnold and discussed with him primary target systems in Japan, with particular reference to coke. General Arnold was, of course, informed that the validity of this target system was tentative pending full Committee approval.

On or about October 4, Brigadier General Wolfe and Colonel Harman called upon the writer and reviewed the Committee's studies. Arrangements were also made for Major Foss of the A-2 Section of the XX Bomber Command to come to Washington and familiarize himself with the Committee's work.

On 16 October 1943, the Assistant Chief of Air Staff, Plans requested an immediate statement on coke ovens as a target, with particular reference to their accessibility from Chinese bases. It was understood that the material was needed for a pending conference with high officials. Such report was accordingly <sup>prepared</sup> with a statement that it did not represent the final judgment of the Committee (Tab 40).

During the month of October, practically all the final subcommittee reports were received, checked and briefed. In general, they disclosed no significant changes in the material submitted at the subcommittee hearings. The exceptions were non-ferrous metals and aircraft.

In October, 1943, the Chairman of the non-ferrous metals sub-committee and the writer visited New York where they held conferences with Dr. Blough of the Aluminum Co., Ltd. and with Mr. Rabbitt, formerly of the International Nickel Company, who had spent many years in Japan.

At this conference, the chairman's preliminary figures on all non-ferrous metals other than aluminum were agreed upon. Dr. Blough explained at great length why his experience in Aluminum, Ltd. convinced him that the acid <sup>clays</sup> process necessary to reduce alumite shales and ores was a difficult and unsatisfactory method and why he therefore did not believe that more than 40,000 tons of alumite could be produced from Manchurian raw materials of this nature. The difficulties with the acid process were (a) the necessity of using special steels to resist corrosion, (b) the fact that the high silica ore used produced an acid compound which could not be satisfactorily used in the electrolytic process. Unless this acid were removed, it would eat up the steel in the processing machinery. Moreover the alumina produced would not be pure because the silica would not have been eliminated. The presence of silica in the alumina would inhibit its use to produce duraluminum. Alumite included minute amounts of potash, perhaps 1/100 per cent, and in the electrolytic process - the sodium baths - the potash tended to accumulate and transformed the sodium baths into potash baths. If this happened, the lining of the furnaces was ruined. The Aluminum Co. had had precisely this difficulty in a plant they had set up in Italy.

Dr. Blough produced some interesting figures with respect to aluminum requirements for aircraft. These figures indicated that approximately 70,000 tons would be required for the production of 15,000 aircraft, assuming a ratio of two single engine fighters to each heavy bomber. He calculated that a single engine fighter required roughly two tons of aluminum (a ~~Zero~~ contained 3500 pounds), a heavy bomber 10 tons and a medium bomber 6 tons. 48 per cent of the tonnage used was in sheets; 13 per cent in shapes and extrusions; 5 per cent in wire rods and bars; 3 per cent in tubing; 11 per cent in forgings; 7 per cent in castings; and 18 per cent, miscellaneous.

Assuming a production of 70,000 tons of aluminum and an allotment of 95 per cent for aircraft production (as in this country and in England) this would leave a net for aircraft of 66,500 tons from which could be produced 9500 single engine fighters (Zeros) and 4750 bombers, a total of 14250 aircraft. This figure was interesting because it tallied with the production figures arrived at by the chairman of the subcommittee and indicated a possibility of higher aircraft production than the chairman of the aircraft subcommittee had estimated. If 40 per cent were required for spares (as in the United States), this would make a total requirement of 100,000 tons per annum. It was interesting to note that the necessary sheet aluminum production was only 31,500 tons, a small figure and well within Japanese rolling capacity.

As Colonel Rice was obliged to depart on a lengthy trip to the Far East, it was impossible for him to complete his report and accordingly Mr. Corry of FFA was substituted as Chairman. Serving on the subcommittee was Mr. Shearer of MFW. These two gentlemen subsequently contacted officials of the Reynolds Metal Co. and of Aluminium Ltd., both of whom took a view contrary to that expressed by Dr. Blough. The subcommittee report as finally submitted therefore, adopted a production figure from alumite shales and clay of 60,000 tons instead of 40,000 tons.

In the case of aircraft, a serious divergence of opinion appeared within the subcommittee. The chairman insisted upon a production figure not exceeding 10,000 aircraft whereas all the other members of the subcommittee held out for a figure of 15,000. Under instructions from the full committee, the original short form of report submitted by the chairman was revised. It was not signed by the chairman who stated he had some reservations as to signing and that he did not believe the Navy cared to be continued in the study. However, at a meeting of the full Committee, held on 11 November 1943, the entire subcommittee was present and all members other than the chairman indicated their desire to submit the revised report. The chairman continued his dissent and this dissent was incorporated under his signature in the report.

work with and in the preparation of a report. This report was not finished.

**IV. PREPARATION OF THE FINAL REPORT**

Early in October, Mr. Root and the writer held conferences in New York at which several tentative drafts were prepared and Mr. Root spent considerable time during that month in writing up summaries of the various industries. The first few drafts were informally coordinated with various members of the Committee and there proved to be remarkable unanimity of views as to the relative priority of the various target systems. From the beginning, merchant shipping and coke held a high economic priority, not only because of their relationship to the Japanese war economy but also because of the extent of our knowledge with respect to them. With respect to shipping, it was clear that the most significant targets would be tankers and railroad ferries.

There was no doubt but that the aircraft industry was a high priority target system. It was apparent, however, that the location of the principal plants, taken together with the range of the B-29, would make it impossible to attack this target system from available Chinese bases in the Chengtu area. Ships at sea did not appear to be profitable targets for B-29's. The petroleum industry was closely tied in to the shipping situation and, apart from the destruction of tankers, the refinery at Pladjoe appeared to be the principal significant target. It was generally agreed that synthetic plants in the Inner Zone would become important targets in the event that Japan were cut off from access to the Outer Zone. Anti-friction bearings and electronic plants were both good target systems.

There was some question as to whether alumina plants might not be attractive targets; the argument against them lay in the fact that the effect of their destruction would principally affect the aircraft industry which in itself was a higher priority target. Nitrogen plants were interesting targets but the effect of their destruction upon the food supply would be long delayed.

Urban industrial areas presented a complex problem. Studies on this subject had not been undertaken by the Committee. As has been previously pointed out, Mr. Horatio Bond of the Office of Civilian Defense had contacted the Office of the Assistant Chief of Air Staff, Intelligence, early in July and Mr. Ewell of the National Defense Research Committee had been assigned to

work with A-2 in the preparation of a report. This report was not finished until late in October 1943 and was presented to the Committee on 1 November 1943, three days before the Committee met to work out a draft of its report. The report concluded that Japanese war industry was more highly concentrated in a few key cities than was the case in Germany, that these cities were far more inflammable than those in Germany and that 1690 tons of incendiaries, effectively placed, would be sufficient to destroy 20 of the most important cities in Japan, having a total population of 16,600,000 (22 per cent of the total) and containing 74 per cent of the priority targets listed in the report of the Assistant Chief of Air Staff, Intelligence, "Japanese Target Data - March 1943". It was estimated that the total production loss would be of the order of 30 per cent and that the period of recuperation would extend from 4 to 6 months. The Committee did not feel that it could do more than restate the estimates of tonnage requirements contained in the study, while pointing out that it expressed no judgment as to their accuracy and stressing the fact that the figures should not be confused with the number of bombs which would have to be dropped in order to effectively place the tonnages stated. On the basis of the evidence presented to the Committee, it was felt that the effects upon the Japanese war effort of such attack would be severe but probably could not be expressed in percentages. It was concluded that the system was an important objective though not one taking priority over primary precision target systems.

The draft presented to the Committee for its consideration was, with relatively minor amendments adopted as the Committee's final report and was submitted under date of 11 November 1943 (Tab 41).

#### XVI. DISPOSITION OF REPORT OF 11 NOVEMBER AND SUBSEQUENT DEVELOPMENTS WITH RESPECT TO RECOMMENDATIONS THEREIN CONTAINED

General Arnold and General Kuter had left Washington for the Cairo conference prior to the formal submission of the Committee report and copies were forwarded to them for their use at the conference.

Subsequent to the opening of the Cairo conference, the subject of coking plants as targets came up before the Joint Staff Planners in Washington. While

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several of the members of the JSP organization (including Colonel Wolfenbarger of the AAF) were absent at the Cairo conference, it appeared that objections to the Committee's conclusions as to coking plants were apparently voiced in the JSP and a cable to this effect was dispatched to the JSP members at Cairo. On 29 November, a cable was received from General Hansell at Cairo requesting an estimate of the effect of destruction of three coke plants representing 61 per cent of Japanese coking capacity. After coordination with General Bissell and Colonel Moss and such other members of the Committee as were available, a reply was dispatched under date of 30 November, estimating an immediate loss of 25 per cent in steel production because of elimination of supplies of coke oven gas used for fuel in certain open hearth furnaces and a reduction of 53 per cent in total steel production during the 12 months following destruction.

It should be noted that the Committee's report had advocated destruction of six targets which would have resulted in an immediate reduction of 30 per cent in steel production for the reasons above stated and in a reduction of 66 per cent in total steel production during the 12 months following such destruction. One of these six targets was situated immediately adjacent to one of the three targets referred to in the cable. The reasons for its omission from consideration in the cable did not appear.

In accordance with a further request contained in the cable, a brief (Tab 42) was prepared and, after approval and initialing by General Bissell, was forwarded to General Hansell under date of 1 December.

#### XVII. THE MATTER OF JIC 152/M

On 3 December 1943, instructions were received to deliver a copy of the Committee's report to the Joint Staff Planners.

On 4 December, the Joint War Plans Committee addressed a memorandum to the Joint Intelligence Committee, requesting an analysis of the optimum timing and deployment of VLR aircraft from various bases against Japan, with particular reference to the COA report. The matter was referred by the Joint Intelligence Committee to the Office of the Assistant Chief of Air Staff,

Intelligence, and to OP-35 of the Navy, a section headed by Commander Bitter, a member of the Committee of Operations Analysts. Within A-2, the matter was handled by the Far Eastern Target Information Section.

On the evening of 17 December, Colonel Moss of A-2 telephoned the writer inviting his participation in a conference to be held the following day between representatives of A-2 and the Navy for the purpose of preparing a reply to the JIC directives.

It appeared that the views of the Navy and of the A-2 representatives as to strategic industrial objectives did not coincide. The Navy representatives adopted the conclusions of the COA report on this matter, whereas certain of the A-2 representatives laid stress on industrial target priorities contained in a report of the Office of the Assistant Chief of Air Staff, Intelligence dated 23 March 1943. This difference was particularly noticeable in the case of coke ovens. Operations from China against coke ovens in northern Kyushu were not favored by certain A-2 representatives. Emphasis was placed instead upon certain electric power targets. In the case of possible operations from the Marianas, the priority targets advocated were those contained in the 23 March report and in the report on Incendiary Attack Data prepared by the Office of the Assistant Chief of Air Staff, Intelligence, under date of 15 October 1943. Both of these contain excellent material and had been carefully considered by the COA. Certain of their conclusions were embodied in the COA report of 11 November 1943 but the COA priority industrial target systems differed significantly from those contained in the 23 March report.

At the close of the meeting, the writer submitted a memorandum to Colonel Moss pointing out that (a) the report, as then drafted, constituted a collateral attack on the COA report (b) the COA report bore the approval of both Colonel Moss and General Bissell, (c) if it were desired to effect any re-evaluation of economic targets on the grounds of new evidence or otherwise, the most desirable procedure would be to submit the matter to the Committee, (d) the tentative conclusions advanced by the Navy appeared unobjectionable.

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The next day, a meeting was held in which the writer was invited to participate. Considerable debate ensued between Naval and A-2 representatives. A new tentative draft of report was submitted by A-2. It appeared to the writer that the conclusions advanced in this report conflicted with those of the COA and that the submission of the report in its then form might serve to confuse higher echelons. A memorandum was accordingly prepared for Colonel Moss, in which specific corrections were suggested. Colonel Moss indicated his agreement therein.

Subsequently the permanent staff of the JIC prepared a report to the Joint Staff Planners in which the report of the COA was referred to and in which it was stated that the Committee had not considered oil targets but had confined itself only to strategic targets in the Japanese Islands. Shortly thereafter, General Bissell, who was then Assistant Chief of Staff, G-2, War Department, telephoned the writer stating that it was his recollection that oil targets had been considered and that it had been decided that the problem was primarily one of shipping and that attack on the Pladjoe refineries had been recommended as a method of increasing this burden. It was explained to the General that his recollection was correct. The Joint Staff Planners, in turn, prepared a paper incorporating the statement of the JIC. The matter was discussed with General Fairchild who directed that the Joint Staff Planners' paper be withdrawn. In the end, JIC 152/M was modified by a statement that the oil problem was primarily one of shipping. The amendment stated that the changes therein contained were purely editorial in nature. However, it is to be noted that no statement was made to the effect that the change accorded with the Committee's report.

Under date of 6 February 1944, there were prepared for the Office of the Assistant Chief of Air Staff, Plans, reports on the economic effects which might be achieved by VLR operations from bases at Chengtu and Davao in 1944-45, from bases in Chengtu and Saipan in 1944-45 and from bases at Davao, Chengtu and Saipan during this period (Tabs 43, 44 and 45). These papers were based upon the Committee's previous report and stressed the targets therein

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recommended.

After some further debate in the Joint Staff Planners, a paper was finally prepared under date of 6 April 1944, entitled "VLR Bombers in the War Against Japan", JCS 742/6, in which it was concluded that the best initial use for the B-29 was

"(a) Against iron and steel in the form of coke ovens and shipping in congested harbors from available bases in China.

"(b) Against petroleum refineries in the East Indies, primarily those at Palembang from bases in Australia or Ceylon."

and that the most important targets in the Far East were "shipping, the petroleum industry in the East Indies, iron and steel in the form of coke ovens, urban industrial areas, aircraft plants, anti-friction bearings and electronics".

It will be observed that these were the targets recommended by the COA. In the Appendix, the COA report was referred to and so much of the Committee's report as preceded the signatures was attached as Annex A. This was approved by the Joint Chiefs of Staff on 10 April 1944.

#### XVIII. ASSESSMENT OF THE RESULTS OF THE COMBINED BOMBER OFFENSIVE

While Colonel Leach and the writer were in London a letter (Tab 46) was dispatched by General Kuter to General Eaker in which the question of an evaluation of the overall effectiveness of the CBO was raised and in which it was suggested that the writer take steps to set up procedure whereby an answer could be obtained and kept up to date. General Eaker explained that he desired that all sources of information on the subject be investigated and that the writer and Colonel Leach satisfy themselves as to material which should be sent to Washington. In this connection, he desired that they confer with the British Joint Intelligence Committee which, at Air Marshal Sir Charles Portal's direction, was attempting such an evaluation. This was done and the report which was then under preparation was discussed at great length. As a result, certain changes were made in the body of the report which in general appeared to adequately cover the difficult problem of evaluating the economic and psychological effects of RAF area attacks. Under date of 20 July 1943, a memorandum was prepared for General Eaker outlining the material

which it was believed should be furnished Washington (Tab 47). General Eaker indicated his complete agreement with the outline of the problem. A letter to this effect was dispatched to General Kuter (Tab 48) and under date of 22 July 1943, General Eaker himself advised General Kuter of his views (Tab 49). Under date of 22 July, a further memorandum was prepared for General Eaker (Tab 50) and the results of conferences at the Admiralty and with the British JIC were covered in a memorandum to General Eaker of the same date (Tab 51). In connection with this latter document, it is interesting to note that as of 3 July 1943, the Admiralty had arrived at the conclusion that attacks on submarine bases were ineffective and that there was no necessity for their continuance. This view accorded with the prior conviction of the Committee.

Under date of 25 July 1943, a report (Tab 52) was prepared for General Kuter summarizing the results of the CBO. A covering letter to General Kuter (Tab 53) advised him of the successful completion of the project.

Upon the writer's return to Washington, it appeared that jurisdictional difficulties had arisen as to the assignment of responsibility and the method of handling the matter of evaluation of the results of the CBO. General Sorensen, A-2, had indicated to General Kuter that this task was a responsibility of A-2 and not of either Plans or the COA. It was finally decided that A-2 would undertake the task in cooperation with representatives of OSS and FEA. Despite this fact, however, the writer and Colonel Leach were called upon by the Office of the Assistant Chief of Air Staff, Plans, to prepare an appreciation of the effectiveness of the CBO for use at the Quebec conference. Such a paper was submitted under date of 1 August 1943 (Tab 54).

A study of the results of strategic bombardment operations in Europe was undertaken by A-2 in cooperation with OSS and FEA. The first report was dated 10 September 1943. It concluded that German single-engine fighter production had been cut by 1200 planes, equivalent to the complete stoppage of all German fighter aircraft production for six weeks, that 2100 German fighters had been destroyed, that excess refining capacity at Ploesti had been wiped out but that a further reduction of 3 million tons of refining capacity would be

necessary before the enemy's military effort would suffer, that one quarter of normal ball bearing production had been eliminated for a period of three months, that the enemy would be deprived of 56 U-boats, that 15,000 tons of rubber had been denied to the enemy and that RAF area attacks had reduced general German industrial output during the second quarter of 1943 by from 5 to 10 per cent. Under date of 10 December 1943, a second report was submitted which pointed out that only 20 per cent of the weight of the U. S. effort expended during the period 1 July to 15 November 1943 had been directed against aircraft, anti-friction bearings, petroleum and rubber. This report was in some contrast to reports submitted by the Eighth Air Force to General Arnold and General Arnold appeared considerably dissatisfied with the progress being made as was indicated by the foreword which he caused to be attached to the report (Tab 55).

On 6 (1) January 1944 General Spaatz was appointed Commanding General, U. S. Strategic Air Forces in Europe and General Eaker was appointed to command the U. S. Air Forces operating in the Mediterranean, under General Spaatz' direction.

On 1 January 1944, the Committee received a directive from the Chief of Air Staff, requesting that a report be prepared analyzing the results of the CBO to 1 January 1944. Such a report was prepared and submitted under date of 27 January 1944 (Tab 56). In this report, the Committee concluded that the report prepared by A-2 on 10 December 1943 was generally sound and that any error therein would be in the direction of conservatism. The Committee went on to point out that only 20 per cent of the effort expended in the period 1 July to 15 November 1943 had been directed against those target systems which the Committee had viewed as primary objectives in strategic bombardment. This report was criticized by General Hansell, Acting Assistant Chief of Air Staff, Plans, under date of 26 February 1944 (Tab 57), on the ground that attacks against submarines were properly a part of the CBO and that although the targets selected in the plan had been based on reports of the COA, the CBO plan itself ~~constituted~~ legal authority for attacks on submarines.

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**XIX. ACTIVITIES OF THE COA WITH RESPECT TO WESTERN AXIS TARGETS SUBSEQUENT TO AUGUST 1943**

Under date of 14 August 1943, a report was prepared for General Spaatz in compliance with his oral request made at La Marse in Tunisia for a listing of the most important industrial targets which could be attacked from central Italian bases (Tab 58). Early in October, a request was received from the office of the Assistant Chief of Air Staff, Plans, for an analysis of the optimum method of coordinating attacks under the CBO from bases in Italy and the UK. The background for this paper was the growing conviction that a centralized command should be established to cover all strategic operations from all available bases against Western Axis. In this connection, the progress of the CBO from bases in Great Britain had not been as rapid as had been hoped and the OVERLORD operation had been approved for the Spring of 1944.

As early as 4 May 1943, a series of memorandum (Tabs 59-65) had been prepared for General Fairchild and General Streett, to assist in the War Department conferences to determine the date on which an invasion of Europe could be undertaken. The view of the War Department prior to this time had been that such operations could not be undertaken before 1945. However, as a result of the conferences, it was tentatively decided that the late Spring of 1944 could be fixed upon for planning purposes.

The paper prepared under date of 12 October 1943 (Tab 66) recommended that attack should be concentrated upon the following target systems: aircraft, ball bearings, precision grinding wheels, petroleum and rubber; and the reasons therefore were stated at some length. Considerable discussion ensued with respect to this paper and a further request was received (Tab 67) for a paper which would outline the minimum number of targets whose destruction would prepare the way for OVERLORD. This paper was designed for use in conferences between General Eaker and Sir Charles Portal. Such a paper was prepared under date of 25 October 1943 (Tab 68) and modified under date of 19 January 1944 (Tab 69) in the light of information subsequently received.

In the latter part of January, a request was received from the office of

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the Assistant Chief of Air Staff, Plans, for comment upon an operational directive of 11 January 1944, prepared by General Spaatz, CG, USSTAFF in Europe and addressed to the Commanding Generals of the 8th and 15th Air Forces (Lt. Generals Doolittle and Eaker). A memorandum was prepared under date of 5 February 1944 (Tab 70) embodying the requested comments. The chief point of interest was the fact that the Erla aircraft plant at Leipzig, a large producer of Me 109's and the Focke-Wulf plant at Krzesinki, an important producer of FW 190's, did not appear to be included. The list of targets did not include the Müller ball bearing plant at Nurnberg nor the grinding wheel targets.

#### IX. THE MATTER OF PETROLEUM TARGETS IN WESTERN AXIS

On [redacted], General Sorensen was relieved as Assistant Chief of Air Staff, Intelligence and succeeded by Major General Clayton Bissell who had returned from command of the Tenth AirForce in India. Under date of 24 December 1943, Colonel Williamson of the Office, Assistant Chief of Air Staff, Plans, addressed a memorandum (Tab 71) to General Bissell as "Senior Member, Committee of Operations Analysts", requesting that the Committee comment on a report prepared by the JIC (JIC 106/2) as to the then state of the Western Axis oil refining industry. This report concluded that there was a close balance between crude oil production and refining facilities, that excess crude refining capacity throughout Europe had been reduced 2,085,000 tons and that any destruction of refining capacity in excess of that amount would directly affect Germany's capacity to wage war. The Committee contacted members of the Enemy Oil Committee and held a meeting on 31 December 1943, at which the subject was thoroughly gone into. The minutes of this meeting are attached (Tab 72). The figures submitted as to supply and requirements for 1943 and estimates of production for 1944 appeared correct but there were serious questions as to (a) figures on crude oil refining capacity on 1 January 1944, (b) figures on excess crude refining capacity as of that date and (c) estimates of 1944 requirements. Discussions with representatives of the Enemy Oil

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Committee disclosed that any differences of opinion on these points could be compromised. Under date of 12 January 1944, the Committee submitted a report (Tab 73) in which it was pointed out that what the experts of the JIC had in mind was principally a further attack upon the Ploesti refineries, that such an attack would not be felt in actual consumption for a period of 5 months thereafter and that a reduction of this amount alone, mitigated in all probability by some reductions in consumption and the use of idle French refining capacity, would cause a curtailment but not a collapse of the German war effort. The Committee pointed out that it had always rated oil high in the list of targets but it did not feel that attack on crude oil refineries alone would be sufficient. For these reasons, it did not advocate disturbing existing target priorities.

Concurrently with this report, the Committee proceeded with a review of the German aviation gasoline position and submitted a report thereon under date of 18 January 1944 (Tab 74). A detailed statement was obtained from Dr. Edward B. Peck of the Standard Oil Development Company with respect to aviation gasoline (Tab 75). The report pointed out that aviation gasoline production was concentrated in four Bergius plants, one at Leuna, one at Poelitz and two at Blechhammer which, together, produced approximately 50 per cent of Germany's aviation gasoline. It was felt, however, that these plants were not particularly vulnerable. Doubts as to the size of stockpiles made it questionable as to whether any immediate effect would be obtained by their destruction. It was again pointed out that the Committee accorded Axis oil targets a high rating and it was recommended that, when sufficient forces were available so that the attack on aircraft and ball bearings was not compromised, attack on oil should commence with attacks on Ploesti, followed by attacks on crude refining capacity in Northern Italy and Germany rather than on the synthetic oil plants. Although not directly so stated, it was inherent in the reasoning of the report that synthetic plants should be attacked in addition, as sufficient forces became available.

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Shortly thereafter, General Arnold stated to Mr. Root that it appeared that the CBO was progressing at such a pace that it would be possible to turn to targets other than aircraft and ball bearings and requested his views as to further target systems. Such a paper was furnished by Mr. Root under date of 22 February 1944 (Tab 76).

Early in March the question of completion of the CBO became a matter of some urgency. With the approach of the OVERLORD operation, the control of the U. S. Strategic Air Forces had been turned over to General Eisenhower. General Eisenhower's Deputy for Air, Air Marshal Tedder, consulted Professor Zuckerman, an "operations analyst" who had been with him and with General Spaatz in Africa, had had a hand in the direction of the air attack on Pantelleria and had made a study of the effects of bombing transportation targets in Sicily. The writer and Colonel Leach had had several conversations with Professor Zuckerman at General Spaatz' rear echelon headquarters at Constantine in the summer of 1943 and had found him an individual of very decided views. Professor Auckerman was convinced, as a result of his studies in the Mediterranean theatre, that the best method of preparing the way for the OVERLORD operation from an air point of view was to concentrate heavy bombardment operations upon marshalling yards in Western Europe. In this view, he was supported by a small group in London. His views, however, were abhorrent to both the American Strategic Air Forces officials and to the Ministry of Economic Warfare. It appeared that Air Marshall Tedder had obtained General Eisenhower's tentative approval to the marshalling yard attacks without the concurrence of General Spaatz. General Spaatz was particularly anxious to continue the CBO and to concentrate upon oil production. However, he could not guarantee to General Eisenhower that the effects of the attack would be decisive prior to the date fixed for OVERLORD. In order to obtain support for his position, General Spaatz sent Brigadier General Cabell, who was acting as his Plans Officer, to Washington with a proposed plan for further air operations which he wished to have approved by the Joint and Combined Chiefs of Staff. A request was received to comment on this proposed plan. The plan contemplated attack on German fighter and ball bearing industries, a large scale attack on petroleum

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and subordinate secondary attacks on rubber tires and stocks and bomber production. It gave as a last resort targets transportation centers in Germany. A report was submitted under date of 12 March to General Hansell of the office of the Assistant Chief of Air Staff, Plans, approving the plan as outlined but suggesting the inclusion of grinding wheel plants in the list of targets (Tab 77). Although the Joint Chiefs of Staff did not choose to take any further action with respect to the CBO because final responsibility had been delegated to General Eisenhower, General Eisenhower was prevailed upon to permit a series of heavy attacks on the German oil industry which were initiated (1) in the month of March. These attacks proved far more successful, particularly with respect to synthetic oil plants than had been estimated. It appeared that the use of 100-pound bombs upon the refinery areas of synthetic oil plants could achieve results far greater than had been thought and that damage to the structures could be effected in a greater degree than previously calculated.

Under date of 10 June 1944, the Committee was requested by the office of the Assistant Chief of Air Staff, Plans, to bring its report of 8 March 1943 up to date in view of the new strategic situation created as a result of the OVERLORD operation. This operation had been launched on 6 June 1944. The request postulated certain assumptions (a) success of OVERLORD, (b) a partial failure of OVERLORD and (c) complete failure of OVERLORD (Tab 78).

The Committee caused a review to be made of the various industries which had previously been analyzed. Certain of these were prepared by personnel of A-2, certain of them by personnel of OSS and FEA and assistance was also received from G-2. The personnel of the Committee underwent certain changes. Col. Mose who had been appointed as a member of the staff of the JIC resigned and was succeeded by Colonel John F. Turner, head of the Analysis Section of the Office of the Assistant Chief of Air Staff, Intelligence. Colonel Lanphier of G-2 was succeeded by Colonel Alfred McCormack, Director of Military Intelligence Service. Colonel McCormack had been a partner of the New York law firm of Davis, Polk & Ward, and had organized the Special Branch of G-2.

It was generally agreed that the most important target systems remained fighter aircraft, anti-friction bearings, oil and grinding wheels. The main issue was whether the attack on fighter aircraft and anti-friction bearings had proceeded to a point where a mere holding action would be sufficient and where all forces available should be turned against oil. Dispersal of aircraft production had reached a point where it was difficult to find worthwhile targets. Considerable evidence was presented to the Committee with respect to the extent of damage inflicted by air attack. It was notable that the tenor of this evidence was most conservative.

The Committee submitted its report under date of 21 June (Tab 80). In this report target systems, in order of their priority, were listed as (1) policing of aircraft, adequate to keep output at present levels, (2) oil, natural and synthetic and (3) ball bearings. These systems were deemed of particular importance in connection with the first assumption postulated, the success of Overlord, as well as on the second assumption, a partial failure of Overlord. In the latter event, attack upon grinding wheels was also recommended. The Committee further pointed out that there was reason to believe that Germany's propellant position was tight and recommended that 16 propellant plants accounting for 50 per cent of German production be seriously considered for attack. This subject is treated at greater length hereinafter.

### III. THE PROPELLANT INDUSTRY.

Under date of 18 May 1944, the Ministry of Economic Warfare reported in its Intelligence Weekly No. 119 (for the week ending 11 May 1944) that the RAF had attacked and destroyed four propellant plants in France during the period 18 March to 2 May 1944. The fact that the Germans were utilizing the French propellant facilities, all of which lay within easy range of British bases, appeared of some significance. This led to a preliminary investigation which disclosed that the four plants which had been destroyed by the RAF and which represented the lion's share of French production had been put into operation during late 1942 and early 1943, for the purpose, first, of reprocessing old

French powder and, second of producing new powder. When the Committee had originally considered the subject of propellants in December, 1942, it was the view, in all quarters, that Germany was not vulnerable as far as ammunition supplies were concerned. It was argued that she had been preparing for some years for a war and that, in addition to her own plants, she had captured facilities in occupied countries whose production could be turned to her own benefit. On the other hand, certain events had occurred subsequent to 1939 which the Germans could not have anticipated. These were (a) the nature and extent of Russian resistance, (b) the scale and intensity of air attack upon the homeland. The German army, subsequent to the first World War, had been built up on the principle of mobility and quick striking power. Of all the European armies, the only one which relied heavily upon artillery was the Russian. During the Russian campaign of 1941 and 1942, and particularly after Stalingrad, it must have become obvious to the Germans that they would have to turn to the strategic defensive and that this would require an increased volume of artillery and anti-tank weapons. There was some evidence that anti-tank weapons, at least, had been ordered in quantities after Stalingrad. In addition, the operations of the U. S. Air Forces increased greatly in scope during 1943. The volume of anti-aircraft fire required to defend German cities against RAF night attack and to defend important industrial installations against daylight precision bombing was far greater than could have reasonably been anticipated. The use of rockets which required great quantities of propellants was also a factor which could not have been anticipated. On this type of reasoning, therefore, it seemed worth while to search for any further indications of possible shortage.

Cables were dispatched by Colonel McCormack's office to Italy and to Normandy requesting that samples of captured German ammunition be analyzed for the purpose of determining the date of its manufacture and, particularly, if possible, the date the propellant therein had been manufactured. Discussion

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with the Ordnance Department and with individuals who had been present at the Anzio beachhead in January 1944, disclosed the interesting fact that the Germans possessed a weight of artillery opposed to us which might have been decisive had it been fully utilized. It was estimated by one individual in the Ordnance Department who had been on Anzio that this artillery was used to only one-tenth of its possible fire power. This same officer reported that ammunition in use in Italy contained a higher percentage of duds than the ammunition used by the Germans in North Africa. It could not be concluded from these statements, however, that there was any general shortage. There might have been local shortages caused by transportation difficulties. Investigation disclosed that aerial attacks on the Italian railroads north of Rome had not progressed to any substantial extent prior to January 1944. A study prepared by the Office of the Assistant Chief of Air Staff, Intelligence and published in IMPACT for the months of July, 1944 indicated that concentrated attack on the Italian transportation system did not commence until late May, 1944 and had not reached a point where railway capacity had been reduced below the level necessary to carry supplies needed by the German divisions in Italy until May 1944.

German ammunition captured in North Africa was one to two years old. On 29 June 1944, there was received a cable report from the Commanding General, Rome Area Command, to the effect that extensive coverage and analysis of several sizeable samples of German ammunition captured from June 9-20, 1944 revealed that 75 per cent had been assembled between February and May 1944 and that dates on the corresponding propellants covered approximately the same period. The area covered by the examination was from Anzio to a point 25 miles north of Rome and the types of ammunition included 88 mm. flak and 105 to 115 mm. shells. These figures tended to indicate that there were no large stores of ammunition in Italy. It was felt, on balance, that if similar evidence of recent markings was received from Normandy and Russia, a good case could be made for attack upon the propellant industry. With respect

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to Normandy, however, it could be anticipated that the Germans would have collected large stocks of old ammunition at fortified points along the coastline. If any shortage of ammunition in fact existed, it was thought that ammunition captured subsequent to a break through would disclose it.

Certain members of the Committee felt that, although a complete case could not be made, the propellant industry presented an excellent "business man's risk". Attack was not advocated if it would interfere with attacks on oil, ball bearings or aircraft, but the large force available in Great Britain and the rapid progress being made upon primary target systems appeared to warrant attack on propellant plants (a) as secondary targets for a large attacking force which was principally directed to primary targets, (b) as targets for attack in case weather conditions prevented attack elsewhere.

It appeared desirable for representatives of the Committee to proceed to Great Britain for the purpose of submitting such material as they had to the proper authorities there and pursuing such further investigations as might be desirable. This program was approved by the Assistant Chief of Air Staff, Plans and by General Arnold. Before the mission left, word was received that Wing Commander Verrity and Lt. Col. Leggett were enroute to the US from the UK to discuss target matters. A meeting was held with these officers at which the Committee's material was presented and was received with interest.

Mr. Root, the writer, and Major James Luke, of A-2, proceeded to Great Britain on 17 July 1944. Mr. Root received a letter of introduction to General Spaatz from General Arnold (Tab 81) and the writer a memorandum from General Kuter directing him to represent the Assistant Chief of Air Staff, Plans (Tab 82). The delegation was received cordially in Great Britain by Brigadier General E. P. Curtis, Chief of Staff, USSTAF,

and by General Spaatz, Commanding General, USSTAF.

Conferences were held with Colonel Hughes who, under General McDonald, Director of Intelligence, had charge of target matters for USSTAF, and with the Ministry of Economic Warfare, particularly Mr. Lawrence and Mr. Turner. The Enemy Objectives Unit of the American Embassy had just received certain labels from Italy, which roughly corresponded to the dates of those covered in the cable to Colonel McCormack from Rome, and was seeking authority to send a delegation to Normandy to check labels and markings both of propellants and other ground force weapons there. The MEW, was in the act of reviewing the propellant industry and had reached a tentative conclusion that propellants were a good target, although for somewhat different reasons than the Committee had held . Mr. Lawrence was quite positive that stocks of propellants were low although he did not have any information of a more definite nature than that in the possession of the Committee. It was the view of the Ministry that six propellant plants accounted for the great bulk of German production instead of the 16 listed by the Committee. On the other hand, the samples in the possession of EOU showed 16 different markings and it was thought by that organization that there were at least 16 targets involved. Photographic cover was essential to disclose the exact status of the industry. This matter was taken up with Major General Anderson. Discussion with all interested parties indicated that there was a general disposition to welcome the Committee's suggestion. A letter to this effect was dispatched to General Kuter under date of 24 July 1944 (Tab 83) and the Committee members returned to the US on 28 July.

XXII. DEVELOPMENTS WITH RESPECT TO THE FAR EAST SUBSEQUENT TO FEBRUARY 1944

In the latter part of February, 1944, the Chairman approved a proposal that the Committee's report of 11 November, 1943, be brought up to date in light of new intelligence. (Tab 84). It had been hoped to accomplish this through the continuation of existing subcommittees or the creation of new subcommittees. The representatives of A-2, however, felt that less effort would be required if given subjects were assigned to each of the participating agencies and if the report so prepared, were circulated to the other participating agencies for comment. (Tab 85). This procedure was adopted on a trial basis but the results were unsatisfactory. Many reports were accompanied by comments indicating various degrees of divergence in view point. Had the subcommittee method been utilized, as previously, most of such differences would have been thrashed out in subcommittee meetings and agreement arrived at.

The reports did not disclose any significant differences in Japanese target systems. Name-plate analyses indicated that aircraft production had increased by perhaps 25%. The attractiveness of anti-friction bearings as a target system was reduced by information to the effect that several new plants were in production. Estimates of production of rolled steel products was reduced from 9 to 7 million tons, due largely to lack of iron ore. Steel capacity figures remained as previously estimated. Excess coking capacity naturally was increased as a result of this information but it was nevertheless estimated that, once bombardment had cut through this excess, significant results, in terms of destruction of steel tonnage, would remain as previously estimated.

On 6 February the Chief of the Air Staff directed the Chairman of the Committee to establish and maintain contacts with such designated Army Air Forces officers charged with operational responsibility for strategic bombardment of industrial targets in the Far East as was necessary to keep them informed of the Committee's studies and the views of Air Force Headquarters with respect to the relative priority of such

targets. The names of these officers were to be determined by AC/AS, Plans (Tab 86).

On 10 February, 1944, AC/AS, Plans, directed that contact be established and maintained with the Commanding General, XX Bomber Command and a trip was made to his headquarters in Kansas for this purpose. (Tab 87)

The Staff of the Twentieth Air Force was composed of members of the Air Staff. At General Fairchild's suggestion the COA was shown on the chart of the Twentieth Air Force as reporting directly to General Hansell on 6 April, 1944, and, under date of/an order was issued whereby the writer, in addition to his other duties, was assigned to represent the Committee on the staff of the Twentieth Air Force (Tab 88).

On 25 April, 1944, the Chief of Air Staff directed the Air Staff and the Twentieth Air Force to determine the weight of U. S. Air Forces' required to accomplish the earliest possible conclusive defeat of Japan. Representatives of the Committee, Lt. Colonel Leach and Colonel Perera, were directed to collaborate with A-2 in establishing the strategic objectives to be destroyed and in estimating force requirements. Full cooperation was received from OP-16-VA of the Navy.

In the interests of conservatism, it was decided to utilize Eighth Air Force experience in estimating bombing accuracy of abortive sorties and target vulnerability and recuperability. It was postulated that daylight visual bombing operations would be undertaken against all primary objective systems. Based on European experience, it was calculated that only 50 per cent of total aircraft dispatched would successfully attack a given target and that only 25 per cent of the bombs dropped (or 12 per cent of the total lift of bombs dispatched) would fall within a 1000-foot radius of the aiming point. Weather data and estimates of forces available were carefully considered. (Tab 89). A program of strategic attack by phases was prepared for this study. This program was concurred in by both A-2 and OP-16-VA of the Navy. A separate paper with respect to the

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possibilities of complementary action against Japanese strategic targets by carrier-based aircraft was prepared by OP-16-VA (Tab 90).

It became increasingly clear as plans for the Far Eastern air war developed that some form of centralized control over VHB operations would be desirable. The bases from which to launch a concentric attack on Japanese strategic targets were widely separated. If the several air forces operating from these bases were to engage in analyses of such strategic targets and determine target priorities, nothing but confusion would result. There were complications with respect to command and with regard to authority of local theatre commanders, both Army and Navy, and with respect to logistics implications. On however, the Joint Chiefs of Staff approved the creation of the Twentieth Air Force for the purpose of conducting all VHB operations against Japan. General Arnold was appointed Commanding General and Brigadier General Hansell was appointed Chief of Staff.

At General Hansell's direction, there was prepared, under date of 9 May, 1944, a program for the use of the Twenty-first Bomber Command from bases in the Marianas (Tab 91), to which a supplement was prepared under date of 9 June 1944 (Tab 92).

During the absence of the writer in England, a report was prepared by A-2 with respect to the use of B-29's. This report did not entirely accord with the paper of 9 May (Tab 91) in which A-2 had concurred. Under date of 5 August 1944, a report was prepared for the Assistant Chief of Air Staff, Plans, (Tab 93) commenting upon the A-2 paper and emphasizing the necessity for concentrating Chengtu-based aircraft upon coke plants on the Asiatic mainland which could not be hit from the Marianas and on the synthetic oil plants in that area. Attack on the aircraft industry and on urban industrial areas in Japan was reserved for the Twenty-first Bomber Command operating out of the Marianas.

On 8 September, 1944, the Committee was directed to revise its basic study of 11 November, 1943, in the light of two assumptions: (1) That

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it was planned to defeat Japan by combined aerial and naval blockade and  
bombardment from present and future bases. (2) That it was planned to defeat  
Japan by combined aerial and naval blockade and bombardment and by invasion  
of the industrial heart of Japan.

A meeting was held on 10 September, 1944, for the purpose of considering the new directive. This meeting was attended by Brig. Gen. Lauris Norstad, Chief of Staff of the 20th Air Force. General Norstad, who had just been appointed to his new position, requested at the meeting that the Committee submit an immediate report with respect to the next full-scale mission of the 20th Bomber Command which was scheduled for the latter part of the month. After examination of the evidence, during which many interesting points were raised, the Committee unanimously concluded that General Norstad should be advised that the next mission of the 20th Bomber Command should be directed against the coke ovens at Anshan (Tab 94).

On 19 September the Navy formally appointed Captain P. D. Stroop, MSN, Commander Francis Bitter, USNR and Commander John Mitchell, USNR, as members of the COA (Tab 95).

On 29 September, 1944, a conference was held in General Arnold's office in which the writer was requested to prepare target data with respect to the implications of the withdrawal of the 20th Bomber Command from Changtu bases and what strategic targets could be attacked from Calcutta, Darwin and from any other place where suitable bases could be prepared in a reasonable length of time (Tab 96).

The Committee held several meetings between 27 September, 1944, and 9 October, 1944, in the course of all aspects of current intelligence with respect to the several Japanese target systems was received and future operational plans and forces available and committed were given in detail by representatives of Plans.

The report of the Committee was submitted under date of 10 October, 1944. (Tab 97). On the assumption that it was planned to defeat Japan by combined aerial and naval blockade and bombardment from present and future bases the report recommended that attack be directed against (a) shipping (b) aircraft (c) urban industrial areas. On the assumption that it was planned to defeat Japan by combined aerial and naval blockade and invasion of the industrial heart of Japan, the report recommended attack against (a) aircraft (b) urban industrial areas and (c) shipping. In addition, attack was recommended against the important coking plants in Manchuria and Korea and the Shale Oil Plant at Fushun. The report contained detailed discussions of the several target systems previously considered in the light of all available intelligence.

On 17 November, 1944, General Norstad, Chief of Staff of the 20th Air Force reported to the Assistant Chief of Air Staff, Plans, that the report had lead directly to the directive covering the operations of his command for the ensuing three months period. (Tab 98). Under date of 22 November, 1944, the Assistant Chief of Air Staff, Plans, stated in writing that the work of the Committee had met with the sincere endorsement of his whole office and that the report of 10 October, 1944, "like its predecessors has been a major factor in the strategic direction of our forces." (Tab 99)

With the submission of its report of 10 October, 1944, the work of the Committee terminated, and its functions were in large part transferred to the Joint Target Group operating in the Office of the Assistant Chief of Air Staff, Intelligence.